PETROLEUM PROCESSING

including Petrochemical Processing Section

JULY 1954

Work-Load Analysis
How one refining company has used this key approach to better shop maintenance — p. 1041

Catalytic Processes
Here's helpful fundamental material on the mechanics of one of refining's most important tools — p. 1048

Booming Aromatics
A solid reason behind the solid rise of the primary petrochemicals — up 38% in 1953 — p. 1067

O. A. Knight—"Management has to change . . ."
His national oil union plan grows stronger — p. 1037

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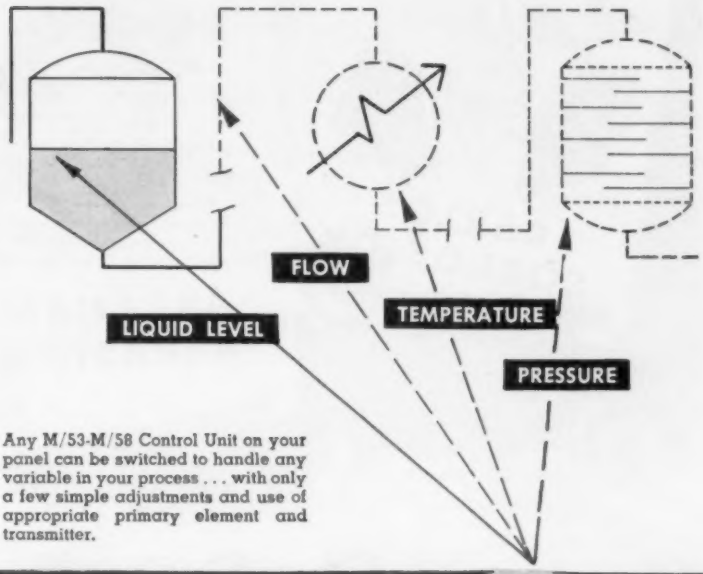

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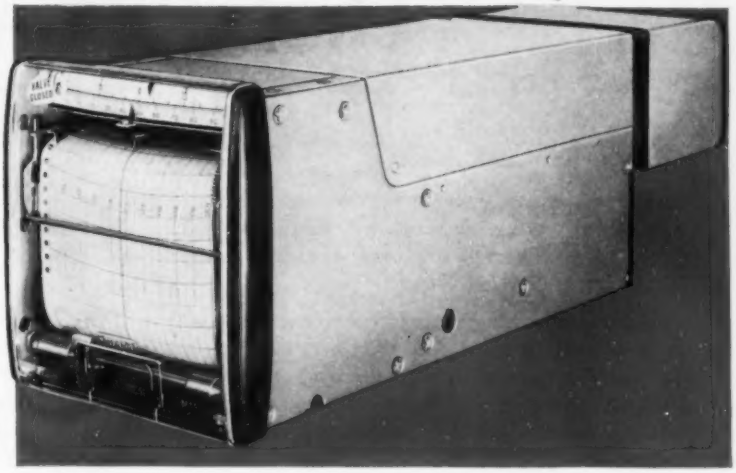

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Covering petroleum and petrochemical research and the design, construction, management, specialized and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals.

July, 1954
Vol. 9, No. 7

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A McGRAW-HILL PUBLICATION

Petroleum Processing is published monthly by McGraw-Hill Publishing Co., Inc. James H. McGraw (1860-1948) founder.

Publication Office: 330 West 42nd St., New York 36, N. Y.

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to **Petroleum Processing**, Subscription Service, 330 West 42nd St., New York 36, N. Y. Subscription rates: domestic single copies 35c, United States and possessions, $2 per year, $3 for two years, $4 for three years; Canada, $3 per year, $4 per two years, $5 for three years; other Western Hemisphere and Philippines, $8 per year, $12 for two years, $16 for three years; all other countries $10 per year, $16 for two years, $20 for three years.

Published prior to Sept. 1946 as the Technical Section of National Petroleum News, devoted to Refinery Management and Petroleum Chemical Technology, and including International Petroleum Technology. Entered as second class matter March 12, 1954 at the Post Office in New York, New York under the act of March 3, 1879. Printed in U.S.A. Copyright 1954 by McGraw-Hill Publishing Co., Inc. All rights reserved.

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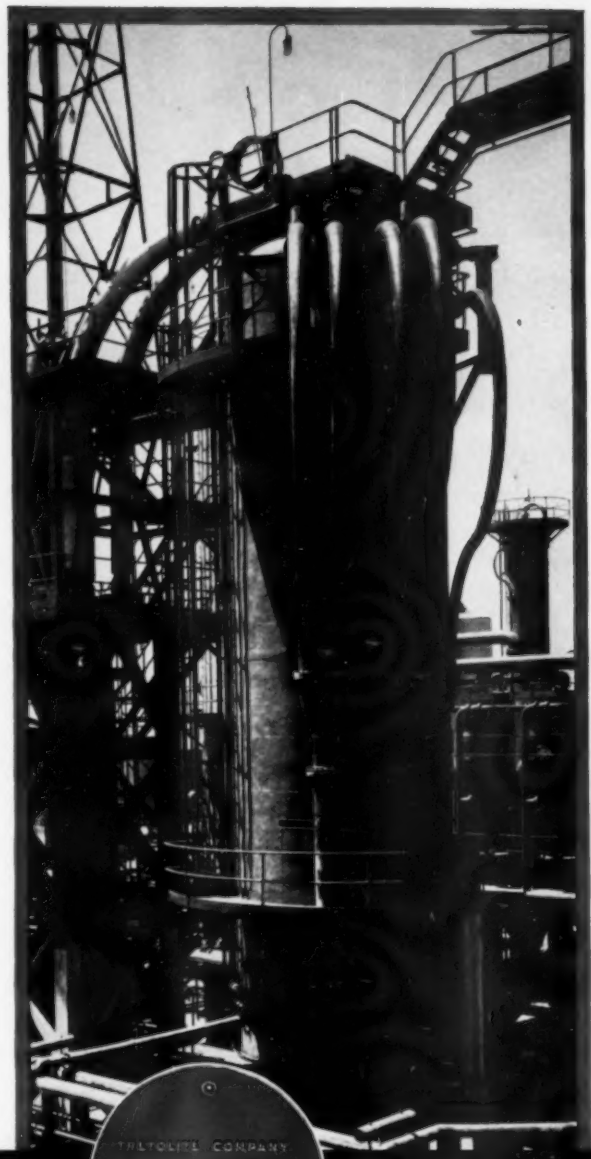

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PETROLEUM PROCESSING

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Are You the "Planager" of the "Petrossory"?

IF you are at all interested in petroleum as a raw material for chemicals, you'll want to be sure to read the story " 'Chemofining' —Petroleum's Future?" in our petrochemical section this month. It starts on pg. 1070.

It's not a technical story in the usual sense of the word; in fact, it's a bit on the Jules Verne-ish side. A couple of Blaw-Knox engineers with a good deal of imagination tell you how you might design a hypothetical "Chemofinery"—a plant which starts out with crude petroleum (10,000 b/d of it, in this case) and converts it entirely, except for plant fuel needs, into "Chemopets." They end up with an annual profit, after taxes, of $22.5 million on an investment of about $74 million.

We don't know of anyone who has yet decided to put up such a plant, but from the fantastic way in which petrochemical plants have been sprouting in recent years we wouldn't be surprised to get an announcement in the next mail of the formation of a new company, Chemoprep Oil Co., and its plans to erect a new 10,000 b/d Chemofinery.

And with all of these newly-coined words bouncing around our editorial department the past few weeks, we did a little day-dreaming ourselves and cooked up a few more. Pretty soon we're going to start talking about petroleum refining, petrochemical manufacturing and gas liquids recovery as one new gigantic "Petrocessing" industry. And the individual plants, whether they are conventional refineries turning out fuels and lubricants, chemical plants making petrochemicals, or Chemofineries, are all going to be known as "Petrocessories" or perhaps as "Petrossories."

William F. Bland
Editor

P.S. (on a completely different subject)—There is one reader of PETROLEUM PROCESSING who probably thinks our Reader's Service Department is strictly for the birds. Last month he sent in one of our reply cards from the March issue, asking for more information on seven "What's New" items and two advertisements. The card was air mailed from Bahrein about the end of May and reached us June 4—and to date we haven't done a single thing to get this chap the information he wants. But if he reads these comments and will send us his *name and address*, we'll give his requests the very promptest attention.

—W.F.B.

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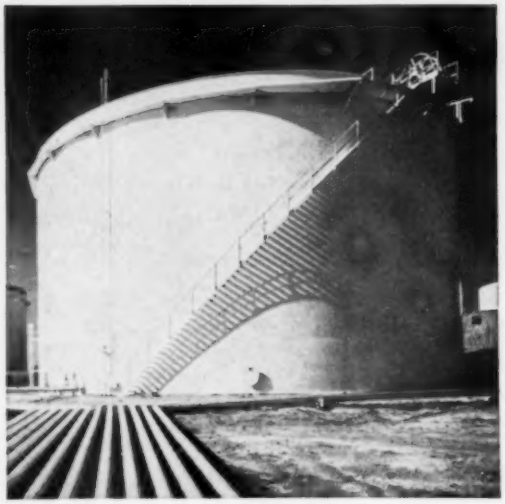

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What's Happening...

in Refinery Expansion

. . . **The Texas Co.** has received fast tax write-off approvals on two new projects. One is for $10,900,000 for a 10,854 b/d catalytic reformer, expansion of an alkylation unit, and installing related facilities at Lockport, Ill. The other is for $6,400,000 for a catalytic reformer, isomerization unit, and related facilities at Los Angeles, Calif.

. . . **Gulf Oil Corp.** will start building this month a 10,000 b/d UOP Platformer at Cleves, Ohio, refinery. Contract has been let to Procon, Inc., with completion date April 1, 1955.

. . . **Pan American Refining Corp.** has revised the design of refinery for Yorktown, Va., to 35,000 b/d initial capacity instead of 25,000 originally planned. General construction contract is expected to be let late this year.

. . . **Salt Lake Refining Co.** subsidiary of Standard Oil of California, will start construction this month of a new 8000 b/d catalytic cracking unit at Salt Lake City, Utah, refinery, with completion scheduled for April, 1955. Cost is about $2,500,000.

. . . **The Texas Co.** has awarded contract for erection of 1926 b/d sulfuric acid alkylation unit at Westville, N. J., to Catalytic Construction Co.

. . . **Clark Oil & Refining Corp.** has broken ground for new 5500 b/d Universal Oil Products Platformer, at Blue Island, Ill., refinery. Procon, Inc., has construction contract and unit is scheduled to go on stream by early fall.

. . . **Standard Oil Co. (Indiana)** has obtained rapid tax write-off approval on $5,296,000 for new 55,000 b/d crude unit and auxiliaries at Whiting, Ind.

. . . **Great Northern Oil Co.** has awarded contract to Fluor Corp. for its new 25,000 b/d refinery at Pine Bend, Minn. Completion is scheduled for about August 1, 1955.

. . . **Mid-West Refineries, Inc.,** has increased crude capacity at Alma, Mich., refinery from 4200 to 10,000 b/d as result of completed expansion program.

. . . **Llano Grande Corp.** has started building a new $5,000,000 gasoline plant near Lehman, Texas, designed to process 25,000,000 cf/d, with contract awarded to Tellepsen Petro-Chem Constructors, and completion scheduled for December 15, 1954.

. . . **Chinese Petroleum Corp.** has awarded Fluor Corp. contract for a 10,000 b/d Type 45 Thermofor catalytic cracking unit at Kaohsiung refinery on Formosa, first of its type on the island.

. . . **International Petroleum (Colombia) Ltd.** is planning to invest $20- to $25,000,000 on construction of a new refinery at Cartagena, on Caribbean coast, with building to start early in 1955.

in Petrochemicals

. . . **Mississippi River Fuel Corp.** has awarded prime contract for new $15,000,000 ammonia plant to Fluor Corp., Ltd. Construction will start immediately on a 4700-acre site near Crystal City, Mo., 35 miles south of St. Louis. Initial capacity will be about 140,000 tons annually of anhydrous ammonia, ammonium nitrate, and ammonium solutions; and first output is expected by early 1956. Mississippi River Fuel recently acquired Natural Gas & Oil Corp. of Shreveport, La., a natural gas and oil exploratory firm.

. . . **Mobay Chemical Co.** is a newly established firm, jointly owned by Monsanto Chemical Co., St. Louis, and Farbenfabriken Bayer, A. G., Leverkusen, Germany. With temporary headquarters with Monsanto, it will manufacture isocyanate chemicals.

. . . **National Petro-Chemicals Corp.** has begun construction of a new polyethylene unit at Tuscola, Ill., with completion expected in spring of 1955. Unit, being erected by M. W. Kellogg, is designed to permit rapid expansion to 3 to 4 times original capacity, in anticipation of growing markets.

. . . **Mississippi Chemical Corp.** has underway its second expansion program at Yazoo City, Miss. Projects will increase output of anhydrous ammonia from present level of 190 tons/day to 300 tons/day, and of ammonium nitrate from present 225 tons/day to 450 tons/day. Estimated cost will be about $4,000,000.

. . . **Shell Chemical Co.** is now producing commercial quantities of para-tertiary-butyl benzoic acid at new plant in Martinez, Calif. Shell says this is first full-scale plant designed to prepare a monobasic aromatic acid by a one-step oxidation process.

. . . **Eleven oil companies** and one independent oil man are among bidders for government-owned synthetic rubber facilities. Companies are: Richfield (in a combined bid with Stauffer Chemical Co. under name of American Chemical Corp.); Esso Standard; Gulf (in combined bid with B. F. Goodrich Co. under name of Goodrich-Gulf Chemicals, Inc.); Humble; Cities Service and Continental in combined bid; Phillips (under name of Phillips Chemical Corp.); Shell (under name of Shell Chemical Corp.); Sinclair Refining; California

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

Standard; and The Texas Co. Independent oil man is Edwin W. Pauley.

About 45 other firms, singly and in combination, also bid, many of them rubber companies.

Government has not disclosed amount of bid nor the specific facility on which offers are being made.

. . . **Ammonia facilities expansion** is shown in ten approvals just given for rapid tax write-offs, totaling almost $67,000,000. They included:

Allied Chemical & Dye Corp., Solvay Process Div., $7,800,000, at Hopewell, Va.

Shell Chemical Co., $371,900, at Pittsburg, Calif.

Dow Chemical Co., Texas Div., $3,600,000, at Freeport, Texas.

Columbia-Southern Chemical Corp., $3,030,000, at Natrium, W. Va.

Atlas Powder Co., $6,750,000, at Atlas, Mo.

Ammonia Chemical Corp. of Calif., $4,000,000, at Oleander, Calif.

Utah Chemical Co., $18,725,000, at Mt. Pleasant, Utah.

Alabama By-Products Corp., $5,800,000, at Tarrant, Ala.

National Distillers Products Corp., $7,000,000, at Tuscola, Ill.

Columbia River Chemicals, Inc., $10,251,000, at Pasco, Wash.

. . . **Gulf Oil Corp.** has started producing iso-octyl alcohol at new Port Arthur, Texas, unit and is shipping product in tank cars, marking firm's initial move into general organic chemical market. Plant has capacity of about 9,000,000 lb./yr. and can be adapted to produce higher alcohols, markets for which Gulf plans active exploration. Oxo process is used.

. . . **Carbide and Carbon Chemicals Co.** has obtained fast tax write-off approval for $2,295,000 on a butadiene plant at Seadrift, Texas.

. . . **Spencer Chemical Co.** has reported planning additional facilities at Henderson, Ky., plant for manufacture of nitric acid, ammonium nitrate, and ammoniating solutions.

. . . **Standard Oil Development Co.** has announced a new petrochemical product for use in paints and plastics. Called "C-Oil," it is based on butadiene. Semi-commercial quantities are being produced at Baton Rouge, but it will be several months before the products reach the market.

in Markets and Prices

. . . **Buyers still held upper hand** in June markets. Refined products prices generally were weak. And concern increased over the general crude price structure. Sellers found it increasingly difficult to make short-term commitments—were shooting for yearly supply arrangements and, in some instances, bought distributing companies outright to assure outlets.

. . . **Standard Oil Co. (Ohio) cut wholesale gasoline** prices 0.85¢, retail prices 1¢/gal. at company stations throughout Ohio. Officials said reductions were made to iron out differentials between depressed price areas in state which were fast becoming rule rather than exception; because of current oversupply of gasoline relative to demand; and to meet competition. Sohio cited fact that gasoline inventories rose contraseasonally early in June—were 15% higher than year ago—represented 49 days' supply as against 44 last year—with demand forecast for next 90 days only a fraction of 1% above actual consumption during June, July, Aug., 1953.

. . . **Buyers of Michigan crude cut postings** 12¢/bbl., blaming competition from Illinois and East Texas. Disparity in prices between Michigan crudes and delivered-in crude prices from other areas made reduction "an economic necessity," said Simrall Div., Roosevelt Oil & Refining, largest buyer of Michigan crudes.

. . . **South Penn reduced its posting** for Penn grade crudes 50¢, to $3.26/bbl. for Bradford district oil. This fell 26¢ short of meeting price ($3.00) posted earlier by Tide Water. Latter said it planned no immediate increase despite South Penn action, pointing out decline on Penn lube oil wholesale prices has been steady for more than year and a half.

Tide Water attributed excessive crude and lube oil stocks to: 1) gradual decrease in demand for Penn lubes due to replacement of steam locomotives and stationary engines with Diesels, 2) large export markets formerly supplied by Penn oils now being supplied by foreign-made products, and 3) increased use of lubes for base stocks made from other than Pennsylvania crudes.

. . . **Heavy fuel hit new low** on current down-move in Mid-Continent—No. 6 priced 5¢ lower at $1/bbl., Group 3. Residual prices were weak throughout Midwest; sellers blamed "low-price" oil from Wyoming-Montana.

Looking Ahead

. . . **More coal-to-oil in India:** The Synthetic Oils Advisory Committee, Srinagar, India, has decided to erect a plant of about 4800 b/d capacity. It is understood that hydrogenation of tar and gasification of coal were most favored methods investigated. Ultimate plans indicate several plants may be set up in various locations in India. Aim is less dependence on oil imports.

. . . **More LPG as motor fuel?** Survey by market research committee of Liquefied Petroleum Gas Ass'n. shows LP-powered buses in U. S. operated by transport companies have increased 16% from 1952 to 1953, and totaled 1663 units at end of 1953. Plans for 1954 indicated 411 contemplated additions.

Many processes are available to the refiner who is projecting a refinery from a given crude. The selection of these various processes at each step of the way is obviously important — both economically and to meet required product specifications.

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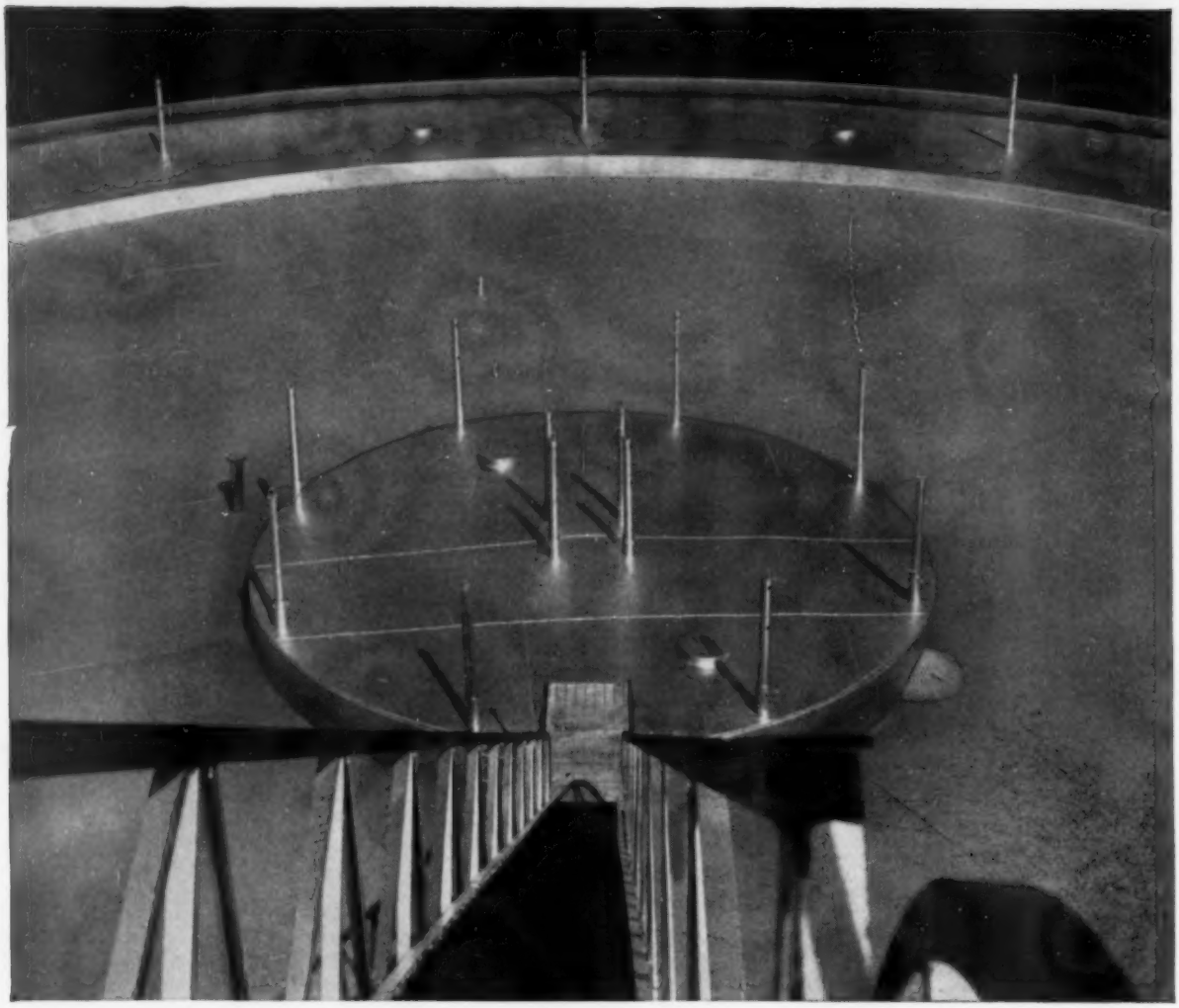

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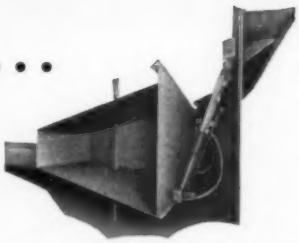

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Increasing Output of Gas Liquids Adds to Processors' Feed Stocks

THE increasingly important position that liquids extracted from natural gas are taking as refiners' potential source material is emphasized in a report dealing with proved reserves of crude oil, natural gas and gas liquids in the U. S., prepared jointly by the API and the American Gas Assn.(1) The report also includes data on proved reserves of crude and gas liquids in Western Canada.

Volume-wise, the production of gas liquids in the U. S. in 1953 (302,698,000 bbls.) was over 13% of our crude oil output of 2,311,856,000 bbls. and was thus an important contribution to the oil companies' source material of hydrocarbons. Ten years ago, these materials were only 7% of our crude oil production.

The proportion of gas liquids production to crude oil output will continue to increase, with the coming active development of new natural gas fields in the U. S. The major portion of our liquefied petroleum gas supplies now comes from stripping and other processing of natural gas before it goes into the pipe lines for distant consumers. The proved natural gas liquids reserves in the U. S. at present, as shown in this study, are nearly 20% of crude oil reserves.

The butane in LPG is now a source material for refiners as a component of their motor fuels. When and if fuel systems in automobiles are improved so that motor gasoline vapor pressure limits can be increased from the present 9 lbs. RVP in summer and 15 in winter, still more butane will go into refiners' motor fuels.

Natural gasolines, the other principal portion of natural gas liquids, are still produced in larger volume than LPG, although the latter is fast catching up. The octane race, however, has pretty much ruled out natural gasolines as straight blending agents for motor fuel, because of their low octane ratings and poor lead susceptibility, in addition to high vapor pressure. Natural gasolines are now valued as processing materials, along with petroleum fractions, in the manufacture of motor fuels and petrochemicals. In this function natural gasoline will have a more important role for petroleum processors in the future.

Lease condensate, another portion of natural gas liquids, is a processing material for refiners by the nature of its transportation from the producing fields along with crude oil in the pipe line.

The definition adopted for natural gas liquids by the API and AGA groups in their study is: "For purposes of developing reserve estimates, natural gas liquids are defined as those hydrocarbon liquids which are gaseous or in solution with crude oil in the reservoir and which are recoverable as liquids by the processes of condensation or absorption which take place in field separators, scrubbers, gasoline plants or cycling plants. Natural gasoline, condensate and liquefied petroleum gases fall in this category." Production of these materials in 1953 and proved reserves as of Dec. 31, 1953 are shown in Table 1.

Table 1—Production and Reserves of Natural Gas Liquids in U. S.(1)

Figures are given in thousands of barrels, and include condensate, natural gasoline and LPG.

State	Net Production 1953	Proved Reserves Dec. 31, 1953
Arkansas	2,556	49,585
California	30,814	324,866
Colorado	650	10,689
Illinois	3,221	17,043
Indiana	36	145
Kansas	4,859	177,728
Kentucky	1,840	7,776
Louisiana	44,779	813,214
Michigan	73	641
Mississippi	3,294	54,734
Montana	221	2,908
Nebraska	201	3,034
New Mexico	10,986	320,657
Ohio	11	1,359
Oklahoma	27,365	304,232
Pennsylvania	141	2,768
Texas	162,403	3,267,242
Utah	4	53
West Virginia	7,141	28,213
Wyoming	2,101	50,559
Miscellaneous*	2	476
Total	302,698	5,437,922

* Includes Alabama, Florida and N. Dakota.

Natural gas liquids of all classifications will be produced in increasing volumes as our crude oil and natural gas producing territories are expanded. They provide an important means of conserving our petroleum resources, and are so recognized by the federal and state authorities. In the future refiners will likely be giving greater attention to using them efficiently, along with other processing materials, in the manufacture of gasoline and petrochemicals. —V. B. G.

(1) "Reports on Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the U.S. and Proved Reserves of Crude Oil and Natural Gas Liquids in Western Canada, Dec. 31, 1953," published jointly by the American Gas Assn. and the American Petroleum Institute.

More Brittle Tank Failures Ahead? Chances Are Slim, Experts Find

THE oil industry has been concerned, and rightfully, over the spectacular failure of two oil storage-tanks in England and one in Canada in 1952. But it looks now as if the laws of chance will play a strong part in deciding where and when the next one will occur. Also, there appears to be little that the average plant can do to make its existing tankage any less susceptible to this failure.

There is much more chance you will lose a tank as the consequence of fire, or explosion, than from brittle failure. Also, chances are, some of the factors required for brittle failure already are present. While comforting, no doubt, it is poor excuse not to try to determine what are the causes and what can be done in future to build more nearly failure-proof storage tanks. All

this came out in a recent symposium on "Oil Storage-Tank Failures."[1]

In a study[2] of such tank failures in this country in the past 35 years, there are a total of 32 reported, of which nine resulted in loss of the tank. But tanks alone are not prone to such failures. A study of the literature[3] brings out that the first brittle failure of an engineering structure was reported in 1879 and a diversity of structures, including gas pipelines, have experienced them since.

The causes are a combination of many factors, among which are the existence of thermal stresses, low ambient temperatures, the extensive use of rimmed and semi-killed steels for constructing tanks which are susceptible to "brittle" failures, and the existence of a "notch effect" which may be due to design, poor workmanship and/or fabrication defects.

Gitzendanner[4] has applied statistical treatment to the record of failures, from which he concludes there is a strong element of chance on whether or not a failure will occur. He finds that the estimated rate of failure is one per 3400 tank-years of service, slightly less than two failures per year for the U. S. oil industry.

Looked at another way, Gitzendanner points out that the loss per failure has been $90,000 on the average and, converted to an insurance basis, gives the following interesting comparison.

Assuming a $100,000 loss per failure, the premium for straight fire insurance coverage would cost $220 per year. For tank failure where no fire occurs, the risk coverage would cost $60 a year. Since there is no general concern about the fire hazard of large storage tanks, the considerably smaller risk of brittle failure does not warrant even greater concern.

That the oil industry isn't just sitting back is evidenced by a study of brittle failure in tank steels[5] where methods are being investigated and already show promise of developing a test or tests for the design of tanks and development of steels "safe" from brittle fractures.

—D. P. T.

(1) Symposium on Oil Storage-Tank Failures, 19th Mid-Year Meeting, American Petroleum Institute, Houston, May 11, 1954.
(2) Samans, C. H., "Results of the Survey of the Study Group on Oil Storage-Tank Failures," Ibid.
(3) Shank, M. E., "Brittle Failure of Steel Structures—A General Engineering Problem," Ibid.
(4) Gitzendanner, F. A., "Some Economic Aspects of the Oil Storage-Tank Failure Problem," Ibid.
(5) Feely, F. J., Jr., and Northup, M. S., "Study of Brittle Failure in Tank Steels," Ibid.

New Communications Inventions Hold Promise for Petroleum

KEEPING pace with the development of new methods of contact that shrink space for human beings, such as the telephone, radio and television, are equally important inventions in communications that have their application in the industrial field.

The oil companies already use some of these new methods in their routine operations, in radio contact with pipeline systems and isolated field operations, and in automatic control of processing units, among other uses. One authority believes we are only on the threshold of applying even newer inventions in the petroleum industry.[1]

Present microwave systems used on pipelines are only the first step in the utilization of such systems, this authority believes. "We now have fully developed, in our hands and available for application, all of the necessary electronic, electrical and servo-mechanism devices necessary for central supervision of a pipeline, partial automatic control with supervision, or fully automatic operation of a pipeline transportation system," including the programming of product flow, as well as product distribution. The recently developed semi-conductor device, the transistor, it is stated, will find application in paging equipment, power line carrier devices, protective relaying, telemetering, and in remote control devices, and at lower maintenance costs than with present communications equipment used for this purpose.

Management will have an important role in the application of these new communications methods in industry. "Since the approach to communications and controlled applications must be from a systems operational point of view," this authority states, "it is essential that such applications be derived from top planning and be moved down through the organization to define objectives and assign specific design requirements and implementation. It is presumptious of any electronic engineer to assume that he can walk into a complex petroleum organization and work out an effective integrated system of control. Over-control and over-complexity are quite as bad as poor control or no control at all. The solution of an operational control problem must be simple and practical, with no frills and no unnecessary electronic appendages.

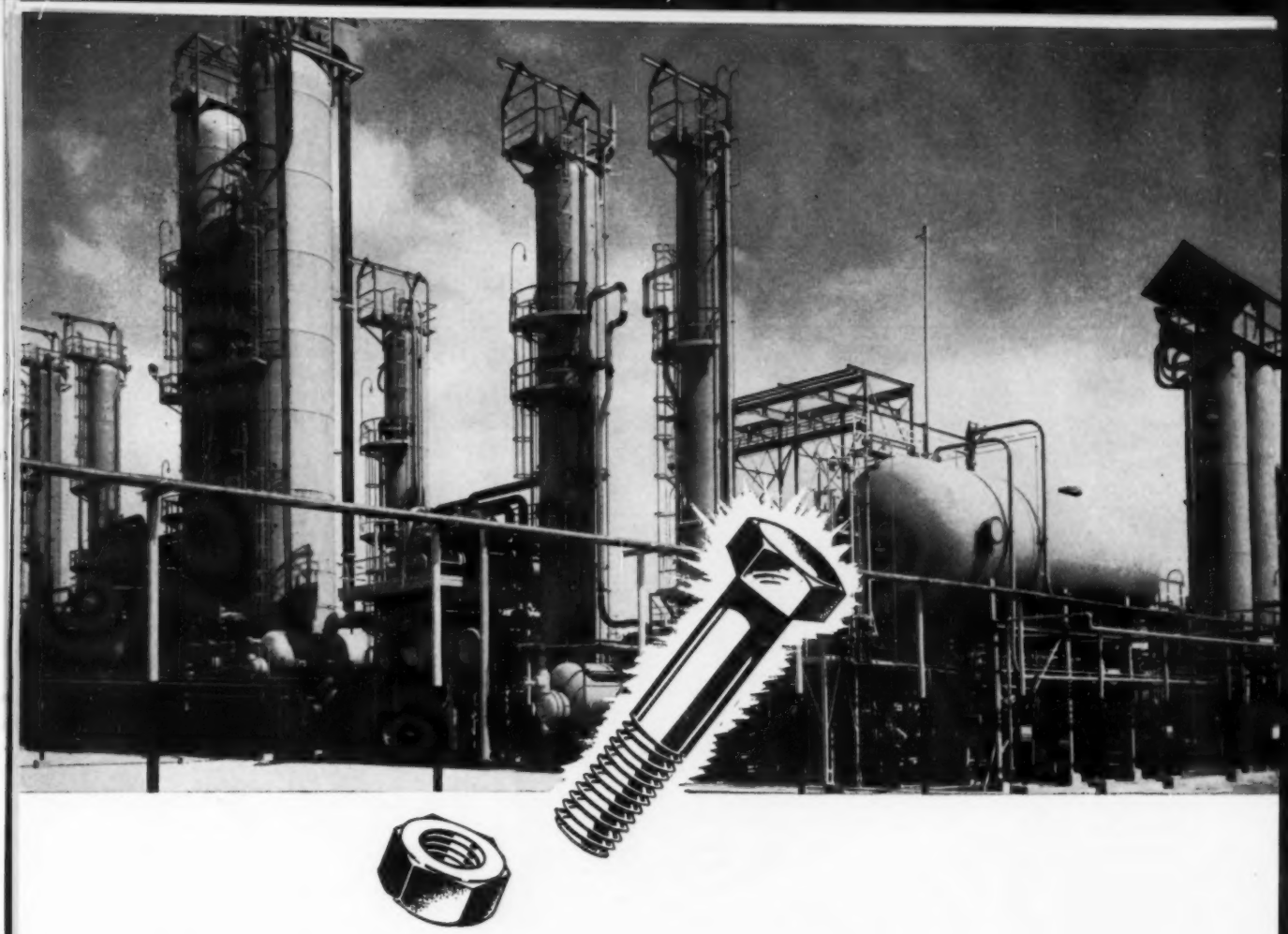
"When top management grants full recognition to the existence and promise of electronic devices and communication means, and, by initiating a study of the overall system requirements, transmits a broad outline of a plan for lowering petroleum operational costs, the ideal approach to the problem will be achieved. With such a necessary directive in force from the top, the operational engineers, working in cooperation with the commercial electronics specialists, can develop the practical embodiment for the system's requirements. . . .

"In almost any complex industrial organization, a study will disclose potential electronic applications which will increase production, increase the capacity of a unit, or otherwise speed up the operation, lower the cost and increase the profit for the overall operation."

The nature of operations in the petroleum industry should provide many special applications for these new methods of communication. Wide geographical areas are covered by individual companies. The raw material involved undergoes many transformations in the change from crude to products, virtually unseen to the human eye. Management should be alert to apply these new methods where they will bring about lower cost operations.

—V. B. G.

(1) "Beyond the Horizons in Petroleum Communications," Daniel E. Noble, Vice President, Communications and Electronics Division, Motorola, Inc., before the Petroleum Industry Electrical Assn., 26th Annual Conference, April 6, 1954.



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Letters

A Firm Stand on Smog

To THE EDITOR: First of all I want to compliment you on an interesting article with respect to the Los Angeles smog problem "Refineries Aren't Top Smog Makers," April, pp. 515-519). We are particularly appreciative of the space given to the objectives of [Southern California Air Pollution Foundation].

While we, of course, are still far from being in a position to make any comments with respect to the smog problem here, we are aware of its great complexity. There is one statement in your article on which I am able to comment, however. That is: "While oil companies will be important financial contributors, other business firms and industries will underwrite the program, too."

This sentence could be, and I think perhaps has been, interpreted as suggesting that oil companies may exert an influence on the activities of this Foundation, conceivably away from complete objectivity. While such an interpretation would, of course, be completely unwarranted, for the sake of making the point crystal clear I would like to point out that the only contribution from the "oil companies" is from the Western Oil & Gas Ass'n. We also have other important contributors. Furthermore, a basic condition of my acceptance of this position, as well as that of my associates, is that we shall operate with absolute and complete objectivity, and any attempt on the part of *any* contributors to influence the direction of our investigations or subsequent findings and recommendations, would result in our prompt resignations.

The Trustees have just had prepared a brochure designed to answer typical questions. I . . . call your attention especially to this statement: "contributions will be accepted on the basis that no donor will be permitted to exercise control over the Foundation's policies or program."

Your article in its entirety makes it perfectly clear that you are under no misapprehension whatever, but at the risk of emphasizing a point that needs no emphasizing I wanted to make sure that the situation was equally clear to your readers.

LAUREN B. HITCHCOCK
President and Managing Director
Southern California Air
Pollution Foundation
704 South Spring St.,
Los Angeles 14, Calif.

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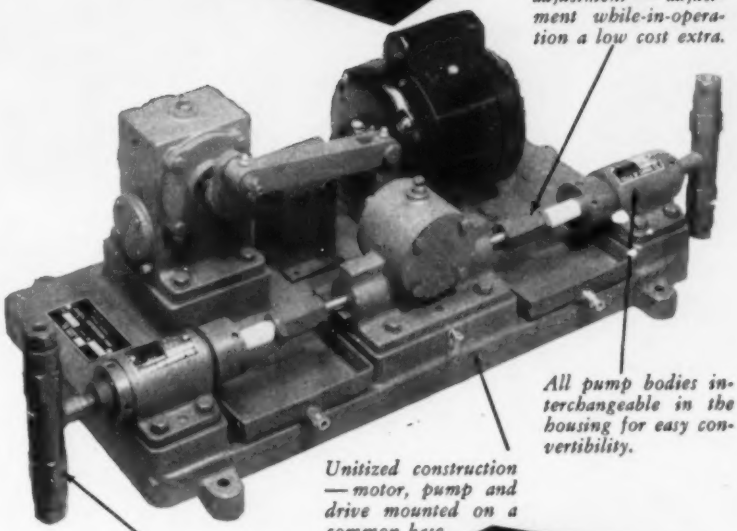
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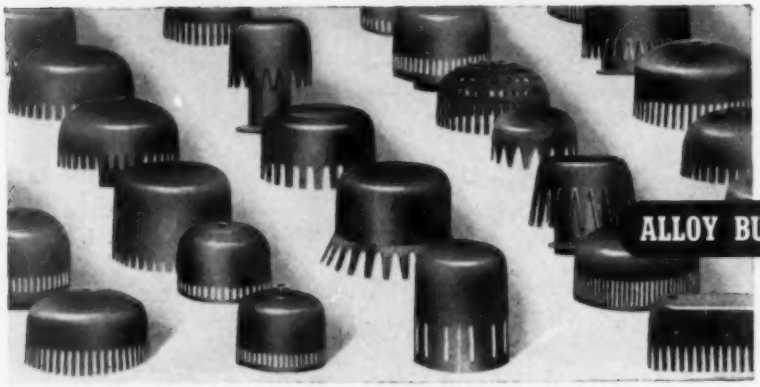

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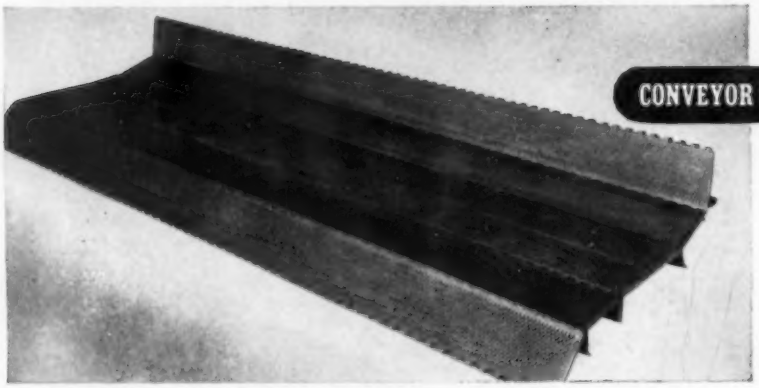

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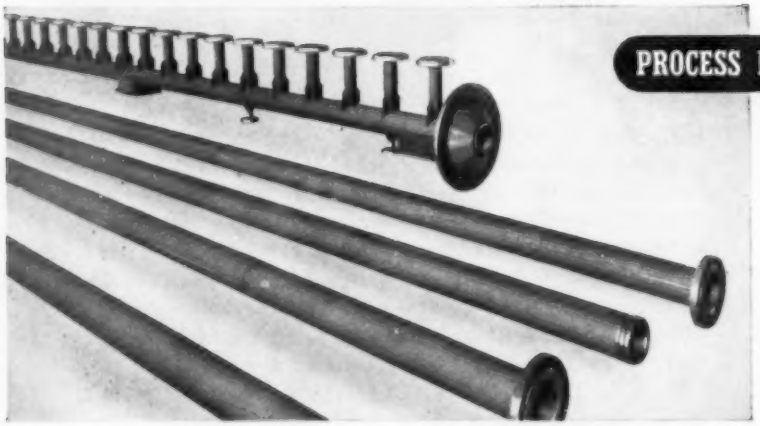

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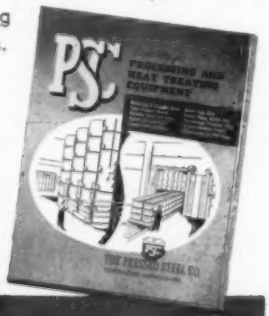

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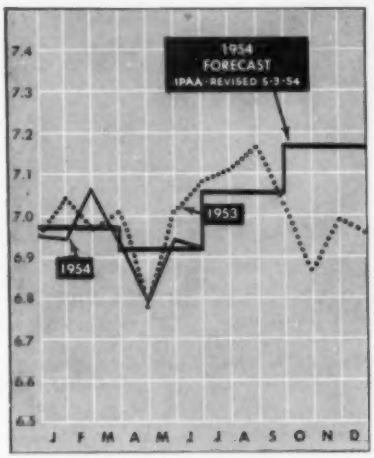
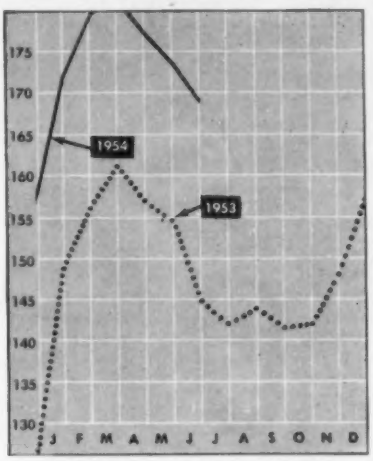
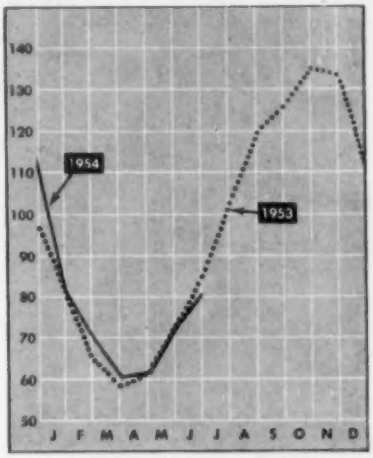


CRUDE RUNS TO STILLS
(Millions of b/d, monthly averages)



PRIMARY GASOLINE STOCKS
(Millions of bbls., end of month)



PRIMARY DISTILLATE STOCKS
(Millions of bbls., end of month)

Gasoline Stocks the Problem Child

OUTLOOK: Third quarter runs will reach above 7,000,000 b/d avg.—Third quarter gasoline demand will be only 3% over 1953.—Buildup in heating oil stocks will lag unless distillate yields are increased.

Crude: The Texas Railroad Commission reversed its position of a month ago, and cut the allowable production in that state for July by 190,234 b/d.

Both the Bureau of Mines and the Independent Petroleum Association of America have revised downward their previous forecast of crude runs in the third quarter. The Bureau's new figure is 7,113,000,000 b/d avg., that of IPAA 7,067,000 b/d.

Gasoline: Other factors than the Texas Commission's alarm over gasoline stocks indicate that motor fuel demand is not running as much over 1953 as was earlier forecast.

The Mines Bureau and the Independent Petroleum Association of America also revised downward their forecast of third quarter gasoline demand; that of the Bureau is 3,717,400 b/d avg., and that of IPAA, 3,720,000 b/d. This indicates an increase in demand for the third quarter of not much over 3% from the third quarter of 1953.

For the ten weeks from April 2 to June 11, U. S. refiners' stocks of gasoline were reduced by 8,371,000 bbls., compared with withdrawals of 11,610,000 bbls. for the corresponding weeks in 1953. East of California stocks were reduced 7,155,000 bbls. in the same period this year, and by 13,707,000 bbls. in 1953. U.S. gasoline stocks June 11, 171,303,000 bbls., were 22,015,000 bbls. higher than the same date in 1953. At the present withdrawal rate, stocks on June 30 will be higher than the 162,000,000 million bbls. forecast, and considerably above the total of 144,882,000 bbls. for the U.S. June 30, 1953.

Heating Oils: Seasonal gains in stocks (distillate and kerosine) into June, were running around 2,530,000 bbls. a week, just under the rate of last year. This rate, however, is not high enough to bring the total U.S. stocks by June 30 to 118,000,000 bbls., as earlier forecast required to prepare for the needs of the coming fall and winter period. Actual heating oil stocks June 30, 1953, were about 111,000,000 bbls. for the U.S.

KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbls. at end of month)

	June 1954*	May 1954	June 1953
CRUDE OIL			
U. S. Production	6.488	6.438	6.595
Imports	.604	.716	.707
U. S. Stocks	277.673	278.347	283.715
Runs to Stills	6.920	6.958	7.081
GASOLINE			
Refinery Output	3.351	3.333	3.410
Refinery Demand	3.675	3.552	3.843
Primary Stocks	169.186	173.218	144.882
HEATING OILS			
Refinery Output	1.651	1.624	1.747
Refinery Demand	1.126	1.127	1.290
Primary Stocks	106.096	95.976	111.162
RESIDUALS			
Refinery Output	1.176	1.166	1.238
Imports	.284	.289	.318
Total Supply	1.460	1.455	1.556
Primary Demand	1.318	1.379	1.506
Primary Stocks	49.020	46.453	43.801

* Through June 18, except Crude Stocks, which are one day later.

PRODUCT AND CRUDE PRICES

Products—¢ gal., weighted average prices in principal refinery markets
Crudes—$/bbl., principal fields
Source—Platt's Oilgram Price Service

	June 1954*	May 1954	June 1953
Gasoline	11.74	11.77	11.94
Distillates	8.95	8.96	8.78
Kerosine	10.35	10.36	10.25
Residual	3.81	3.86	3.61
Above 4 Products	8.87	8.90	8.88
Lube Oils	16.70	16.93	17.59
Crude	2.81	2.81	2.73

REFINERY YIELDS

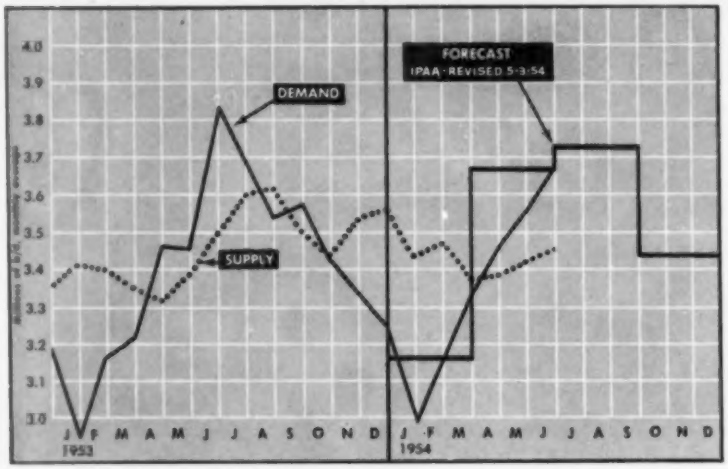
% on Crude Runs to Stills

	June 1954*	May 1954	June 1953
Gasoline	43.9	43.8	43.9
Kerosine	4.0	4.2	4.3
Distillates	19.8	19.1	20.3
Residuals	17.0	16.8	17.5

* Through June 18

SOURCE OF DATA (except prices): Apr., May and June, API weekly reports: earlier months, Bureau of Mines.

Rate of Gasoline Output Is Under 1953

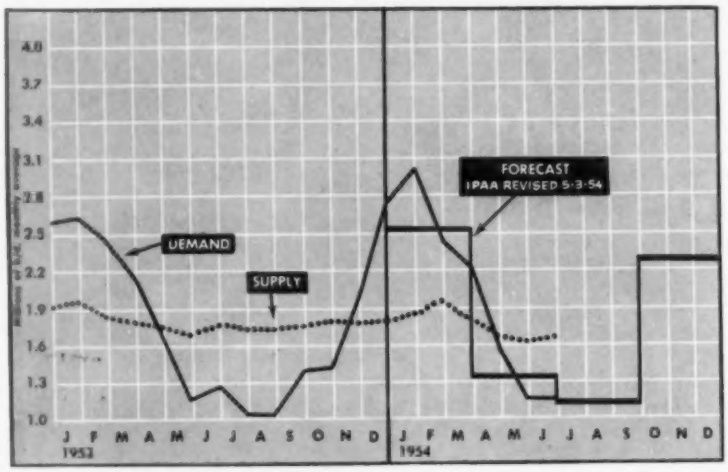


MOTOR FUEL

SUPPLY (Millions of b/d)	From Crude	From Nat. Gas	Total
June '54*	3.036	.415	3.451
June '53	3.112	.396	3.508
Change	—.076	+.019	—.057
% Change	2.4	4.8	1.6
DEMAND (including Exports) (Millions of b/d)			
June '54*			3.675
June '53			3.843
Change			—.168
% Change			4.3
TOTAL SUPPLY (Millions of bbls.)			
5 Mos. '54	456.314	60.209	516.523
5 Mos. '53	453.697	56.495	510.192
Change	+2.617	+3.714	+6.331
% Change	0.6	6.6	1.2
TOTAL DEMAND (including Exports) (Millions of bbls.)			
5 Mos. '54			498.987
5 Mos. '53			490.359
Change			+8.628
% Change			1.8

* Through June 18

Heating Oil Demand in Off-Season Doldrums

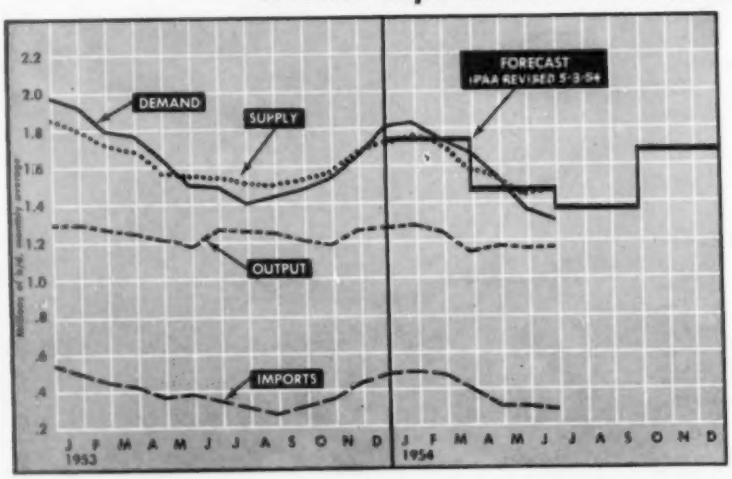


HEATING OILS

PRODUCTION (Millions of b/d)	Kerosine	Dist. Fuels	Total
June '54*	.279	1.372	1.651
June '53	.307	1.440	1.747
Change	—.028	—.068	—.096
% Change	9.1	4.7	5.5
DEMAND (including Exports) (Millions of b/d)			
June '54*	.166	.960	1.126
June '53	.192	1.098	1.290
Change	—.026	—.138	—.164
% Change	13.6	12.5	12.7
TOTAL PRODUCTION (Millions of bbls.)			
5 Mos. '54	53.179	215.937	269.116
5 Mos. '53	54.362	220.131	274.493
Change	—1.183	—4.194	—5.377
% Change	2.2	1.9	2.0
TOTAL DEMAND (Including Exports) (Millions of bbls.)			
5 Mos. '54	58.180	256.560	314.740
5 Mos. '53	57.851	247.922	305.773
Change	+.329	+8.638	+8.967
% Change	0.6	3.5	2.9

* Through June 18

Smaller Imports Hold Down Residual Supply



RESIDUAL FUELS

SUPPLY (Millions of b/d)	Refinery Output	Imports	Total
June '54*	1.176	.284	1.460
June '53	1.238	.318	1.556
Change	—.062	—.034	—.096
% Change	5.0	10.7	6.2
DEMAND (Including Exports) (Millions of b/d)			
June '54*			1.318
June '53			1.506
Change			—.188
% Change			12.5
TOTAL SUPPLY (Millions of bbls.)			
5 Mos. '54	182.190	58.886	241.076
5 Mos. '53	188.842	63.231	252.073
Change	—6.652	—4.345	—10.997
% Change	3.5	6.9	4.4
TOTAL DEMAND (Including Exports) (Millions of bbls.)			
5 Mos. '54			244.941
5 Mos. '53			261.357
Change			—16.416
% Change			6.3

* Through June 18

SOURCE OF DATA: Apr., May and June, API Weekly reports; earlier months, Bureau of Mines.

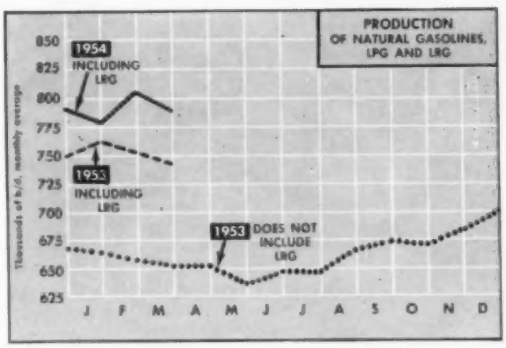
RUNS TO STILLS and DISTRIBUTION OF PRIMARY STOCKS BY U. S. REFINERY DISTRICTS

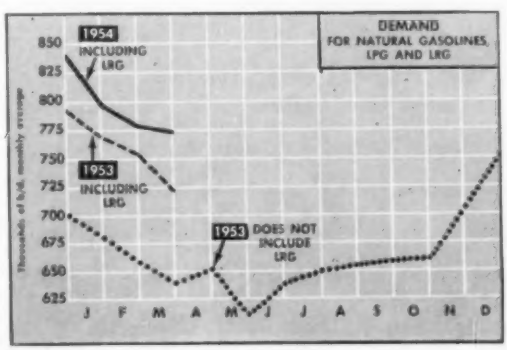
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

Districts	RUNS TO STILLS (Millions of b/d average for week ending on date shown) June 18 1954	June 19 1953	Change	% Change	GASOLINE STOCKS (Millions of bbls., on date shown) June 11 1954	June 12 1953	Change	% Change	RESIDUAL STOCKS (Millions of bbls., on date shown) June 11 1954	June 12 1953	Change	% Change
East Coast	1.039	1.069	—.030	2.8	37.391	34.376	+3.015	8.8	9.666	11.800	—2.134	18.1
Gulf Coast	2.178	2.294	—.116	5.1	30.666	27.591	+3.075	11.1	5.861	8.012	—2.151	26.8
Total Coastal	3.217	3.363	—.146	4.3	68.057	61.967	+6.090	9.8	15.527	19.812	—4.285	21.6
Appalachian	.204	.190	+.014	7.4	7.099	5.077	+2.022	39.8	.856	.617	+.239	38.7
Ind.-Ill.-Ky.	1.246	1.245	+.001	0	37.928	29.922	+8.006	26.8	4.381	3.272	+1.109	33.9
Okla.-Kans.-Mo.	.640	.619	+.021	3.4	17.587	15.857	+1.730	10.9	1.331	1.255	+.076	6.1
Other Inland	.588	.600	—.012	2.0	19.024	16.112	+2.912	18.1	2.397	2.335	+.062	2.7
Total Inland	2.678	2.654	+.024	0.9	81.638	66.968	+14.670	21.9	8.965	7.479	+1.486	19.9
Total East of Calif.	5.895	6.017	—.122	2.0	149.695	128.935	+20.760	16.1	24.492	27.291	—2.799	10.3
California	.998	1.009	—.011	1.1	21.608	20.353	+1.255	6.2	24.038	16.304	+7.734	47.4
Total U. S.	6.893	7.026	—.133	1.9	171.303	149.288	+22.015	14.7	48.530	43.595	+4.935	11.3

Districts	DISTILLATE STOCKS (Millions of bbls., on date shown) June 11 1954	June 12 1953	Change	% Change	KEROSINE STOCKS (Millions of bbls., on date shown) June 11 1954	June 12 1953	Change	% Change	TOTAL HEATING OIL STOCKS (Millions of bbls., on date shown) June 11 1954	June 12 1953	Change	% Change
East Coast	24.918	26.098	—1.180	4.5	10.212	10.936	—.724	6.6	35.130	37.034	—1.904	5.1
Gulf Coast	11.815	16.686	—4.871	29.2	5.223	5.460	—.237	4.3	17.038	22.146	—5.108	23.1
Total Coastal	36.733	42.784	—6.051	14.1	15.435	16.396	—.961	5.7	52.168	59.180	—7.012	11.8
Appalachian	2.015	1.316	+.699	53.1	.836	.813	+.023	2.9	2.851	2.129	+.722	33.9
Ind.-Ill.-Ky.	14.187	11.761	+2.426	20.6	5.506	4.678	+.828	17.7	19.693	16.439	+3.254	19.8
Okla.-Kans.-Mo.	8.793	8.649	+.144	1.7	1.366	1.504	—.138	9.2	10.159	10.153	+.006	0
Other Inland	4.759	4.441	+.318	7.2	1.228	1.126	+.102	9.0	5.987	5.567	+.420	7.5
Total Inland	29.754	26.167	+3.587	13.7	8.936	8.121	+.815	10.0	38.690	34.288	+4.402	12.8
Total East of Calif.	66.487	68.951	—2.464	3.6	24.371	24.517	—.146	0.6	90.858	93.468	—2.610	2.8
California	11.008	10.234	+.774	7.6	.436	.387	+.049	12.7	11.444	10.621	+.823	7.7
Total U. S.	77.495	79.185	—1.690	2.1	24.807	24.904	—.097	0.4	102.302	104.089	—1.787	1.7

Natural Gas and Refinery Gas Liquids





SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

CURRENT PRODUCTION (1000 b/d monthly average)	Mar. 1954	Feb. 1954	Mar. 1953
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	332	356	307
Natural Gasoline and Isopentane	265	257	247
Condensate	30	27	25
Finished Gasoline, Naphtha and Others	55	65	73
Total Natural Gasoline and Cycling Plant Production	682	705	652
Liquefied Refinery Gases	105	102	89
Total Marketable Gas Liquids	787	807	741
Lease Condensate	107	102	98
Total Natural Gas Liquids	894	909	839
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	418	438	375
Natural Gasoline, Isopentane and Others	353	339	344
Total Current Demand	771	777	719

CUMULATIVE PRODUCTION (1000 bbls.)	Mar. 1954	Mar. 1953
LPG and LRG	40,168	36,802
Natural Gasoline, Isopentane and Others	30,958	31,000
Total Marketable Gas Liquids	71,126	67,802
CUMULATIVE DEMAND (1000 bbls.)		
LPG and LRG	39,385	36,415
Natural Gasoline, Isopentane and Others	31,014	30,713
Total Cumulative Demand	70,399	67,128

STOCKS (1000 bbls., end of Month)	Mar. 1954	Feb. 1954	Mar. 1953
LPG and LRG	5,260	4,700	2,674
Natural Gasoline, Isopentane and Others	4,832	4,924	4,362
Total Stocks	10,092	9,624	7,036

THIS 400,000 Pounds per HOUR

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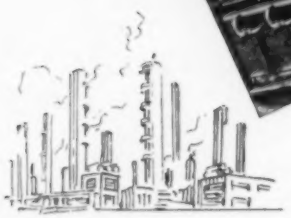
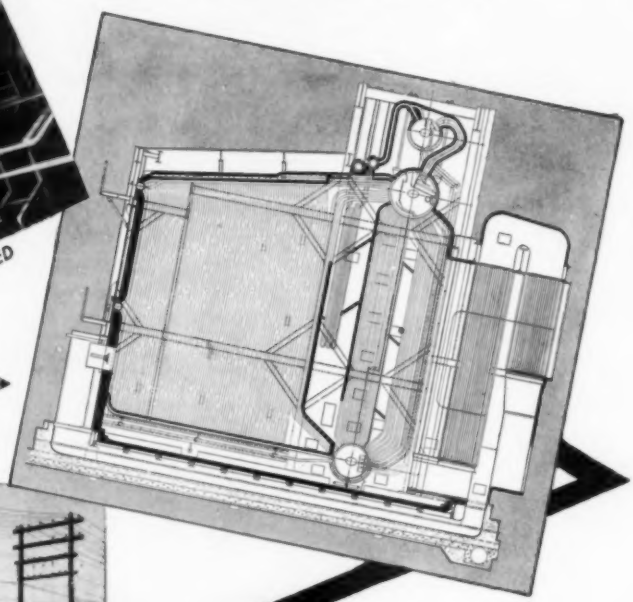
STEAM GENERATOR

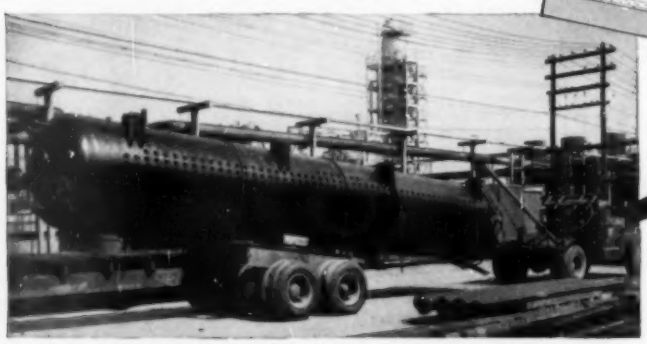
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT →
LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

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PETROLEUM CHEMICALS DIVISION NEWS

DU PONT REG. U.S. PAT. OFF.

July ★ One of a Series of Interest to the Petroleum Industry ★ 1954

NEW WEST COAST TERMINAL FACILITIES

Beginning in August of this year, refiners in the northern Washington area will be able to receive tetraethyl lead shipments direct from the new Du Pont terminal which is being constructed near Ferndale.

The terminal will supply TEL either in railroad tank cars or tank trucks, both of which can quickly deliver the compound throughout this rapidly expanding refinery area.

New Movie to Help Your Dealers Handle Gasoline Complaints

The chances are that your *products* get the blame whenever a customer's car begins to act up. And your dealers are on the firing line whenever a customer complains.

The gasoline, however, is not always at fault when an engine knocks or fails to function properly. The trouble is often caused by such natural factors as low humidity or high temperature . . . by mechanical factors such as too lean a carburetor setting, an overadvanced spark, or a faulty water pump, thermostat, fan belt or other engine troubles that cause excessively high engine temperature. Poor driving habits also increase the tendency for knock to occur.

But your big problem is teaching dealers to explain these common causes of knock to customers in a salesmanlike way. To help you solve this problem, the Du Pont Petroleum Chemicals Division is now making a movie which explains simply and graphically the common cause of knock.

The Petroleum Laboratory's completely equipped chassis dynamometer is being used in the movie to show how various factors cause knock by their influence on combustion reactions.

The movie script and demonstrations are easy to understand and remember. It will be, therefore, suitable for showings to customer groups as well as for use in your dealer training program.

Production of the movie is not expected to be completed until later this year. Its availability will be announced at that time.

Spindletop Roars in Again for Multi-million TV Audience

Du Pont makes movie about this famous oil well for "Cavalcade of America" TV program

When she blew 'er top, the world went into high gear. That is how a schoolboy might describe the momentous occasion of January 10, 1901, when Spindletop gushed up and spattered her wooden derrick over the Texas landscape.

SPINDLETOP COMES IN with a roar of gushing oil that sends her derrick flying. It is a moment of triumph for Anthony Lucas and his wife Caroline, played in the film by William Bishop and Nancy Hale.

Photographs courtesy of General Petroleum Corporation, who rendered valuable assistance in filming "Spindletop."

The blowout of this fabulous well that tapped the tremendous petroleum resources of the Texas Gulf region is one of the epic moments in the history of our oil industry. Early this year, the scene was dramatically re-created and filmed for television so that millions of Americans can know the story as it happened.

Authentic Tools

Although filmed in California, the movie is authentic in mechanical and historical detail. To properly set the stage, old-time drilling tools were scouted out of rusting junk heaps on

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Spindletop*

leases all the way from Maricopa to Coalinga. Mariana No. 77 at the south end of Belridge field was chosen as the blowout site. In the final scene, the old wooden derrick that had stood for something like 30 years over Mariana No. 77 is completely and realistically destroyed by the terrific pressure of the blowout.

IN ORDER TO REACH the final depths of Spindletop, Captain Lucas designed this special steam valve equipment.

Network Telecast

The "Spindletop" film was specially made by Du Pont for showing on the "Cavalcade of America" television program on May 11. This program is seen by an average weekly audience of 12.5 million viewers. The theme of the movie is one that tells a powerfully dramatic and convincing story of the rugged pioneering spirit typical of the American Oil Industry. As such, this first showing had considerable public relations value for the whole industry.

Captain Lucas' Struggle

Like all "Cavalcade" programs, the "Spindletop" story revolves around an individual who has carved a place in

OIL DRILLING equipment, typical of the times, is used in the staging of the movie.

our country's history through outstanding accomplishment . . . in this case, Captain Anthony Lucas.

The setbacks and heartbreaks of wildcatting—as well as the drama, the excitement, and the thrill of success—are accurately portrayed in the film . . . as seen through the struggle of Captain Lucas to push through to success a venture he believed in.

Available to you

Prints of the "Spindletop" film are now available to your company for use in your own public relations program. Address your request to any of the Du Pont Petroleum Chemicals Division regional offices listed below.

SALES PROMOTION MANAGER

R. CARTER W. JONES was recently named Sales Promotion Manager of the Du Pont Petroleum Chemicals Division.

A graduate of the University of Virginia with a B. S. degree in chemistry, Mr. Jones joined the Du Pont Company in 1936 as a chemist at the Jackson Laboratory. In 1939 he was made manager of the Du Pont Tetraethyl Lead Laboratory.

He then became a sales correspondent for chemical intermediates. And from 1941 to 1946 he was engaged in research work at the Du Pont Petroleum Laboratory. After this, he was assigned to the Technical Section of the Petroleum Chemicals Division. Mr. Jones transferred to the Division's Sales Promotion group in 1950.

R. CARTER W. JONES

Regional Laboratories Offer Aid to Refiners on Antioxidant Sweetening Problems

TOM BINFORD, Supervisor of the Du Pont Petroleum Chemicals Division West Coast Regional Laboratory, calibrates the air regulator during a plant antioxidant sweetening trial at a West Coast refinery.

To be practical, results of laboratory antioxidant sweetening trials – even when run with your own refinery stocks – have to be adapted to plant practice.

During the past years, our five Regional Laboratories have gained considerable experience in this work. As a result, we can offer you valuable assistance in setting up and operating an antioxidant sweetening process.

A Du Pont representative will be glad to consult with your own personnel right at the refinery on equipment selection and installation. And during a plant antioxidant sweetening trial, he will help in the testing for antioxidant and mercaptan content, on sampling of refinery stocks, and in checking antioxidant and air addition equipment.

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A-7551

Printed in U. S. A.

POLYRAD CONTROLS CORROSION REGARDLESS OF pH

Specifically developed to control corrosion at low pH, Polyrad is a highly effective inhibitor over the entire pH range encountered in refinery operations. For example, in strong acids, such as HCL with pH under 0.1, Polyrad provides more than 98 per cent protection at temperatures as high as 180°F.

Polyrad, a filming amine inhibitor developed through Hercules research, forms a protective molecular film to shield refinery equipment from hydrogen-ion attack by organic and inorganic acids. From crude units to gas plant areas, Polyrad helps maintain throughput, increases heat transfer, reduces metal loss, and cuts down time for maintenance.

A plus feature of Polyrad is its detergent action which loosens iron sulfide and other scales so the fluid stream can remove them from process equipment.

Polyrad is quickly available from conveniently situated stocks. We would like to work with you in evaluating it under your specific operating conditions. As a preliminary step, write Hercules for descriptive brochure.

Naval Stores Department

HERCULES POWDER COMPANY

INCORPORATED

984 Market St., Wilmington 99, Del.

POLYRAD®

FILMING AMINE INHIBITOR

NA54-2

New instrument covers the increasingly important near-infrared region.

The Beckman Model DK Spectrophotometer is the first commercially-available instrument designed specifically for the near-infrared region of the spectrum—filling an important gap in spectrochemical analysis. Its lead sulfide detector and quartz monochromator permit high-speed transmittance recording at cost and performance unmatched by conventional infrared instruments. Using a photomultiplier detector for ultraviolet work, the Model DK offers a guaranteed wavelength range of 220 to 2700 mμ—wider than that of comparable spectrophotometers twice the price.

The DK's "double-beam ratio" principle is a unique system for percent transmittance recording. (1) It provides the stability of double beam operation, with a single receiver. (2) The fast beam chopping (480 times per second) takes full advantage of the sensitive lead sulfide detector.

Resolution	0.1 mμ at 220 mμ; 2.5 mμ at 1000 mμ; 5 mμ at 2500 mμ—higher than any other instrument in its price range.
Scanning Speeds	For the entire 220 to 2700 mμ range, any of 5 speeds is selectable: 5, 15, 50, 150 or 500 minutes. At highest speed, the near-infrared is traversed in one minute, while very low speeds are available for extreme resolution.
Stray Light	Less than 0.2 percent 0.2 – 2.5μ
Recording Features	Ozalid-reproducible paper...adhesive strips for easy wavelength reference...chart speeds of ½, 1 and 2 inches per minute...

For additional information write for data file No. 98-23

Beckman *division*
BECKMAN INSTRUMENTS, INC.

(To obtain more data on advertised products see page 1112)

Burn Low Grade Fuels – Efficiently . . .

The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

. . . with a LJUNGSTROM *air* PREHEATER

Low grade tars, pitches and asphalts used to be considered so low in recoverable heat value that they were often discarded. But the Ljungstrom Air Preheater points the way to the practical, efficient use of these former waste products.

Preheated air is a key factor in more efficient combustion, causing faster ignition and a short, hot flame. Rates of heat liberation are higher, too. Thus, with preheated air, low grade fuels with high ash and moisture content – and excessively lean fuels – are readily burned.

You get other advantages with a Ljungstrom, too: lower fuel costs . . . more economical furnace design . . . greater throughput . . . higher product quality – *all of these with the Ljungstrom, that pays out in just a few months.*

Wherever you are planning to expand or modernize your fuel burning equipment, it will pay you to consider a Ljungstrom Air Preheater. Call or write for full information.

THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.

WHEREVER YOU BURN FUEL, YOU NEED LJUNGSTROM

Here's How To Hold On

ROCKWELL-Nordstrom

It takes a really efficient valve to hold light ends and petrochemicals. Rockwell-Nordstroms are the ideal valves for these services because they assure positive, dependable control with a minimum of maintenance.

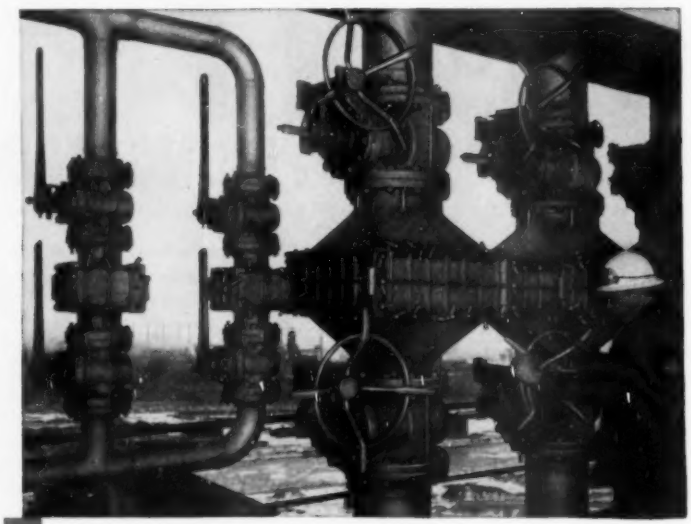
A pressurized lubricant film between the valve plug and the body seals even the lightest hydrocarbons and eliminates uncertain metal-to-metal closure.

Pressurized lubrication also eliminates metal-to-metal friction on the working surfaces which means long-term economy in the maintenance of the hundreds of valves used in each refining and petrochemical operation. Less wear means less care and replacement . . . lower costs.

Rockwell-Nordstrom valves are manufactured in sizes through 30 in. Certain sizes are available in pressure ratings of 10,000 lb WOG.

Find out how Rockwell-Nordstrom valves

BUTANE STORAGE The Rockwell-Nordstrom valves on these butane storage tanks provide "no leak" service whether operated once a month or once every hour. Valve wrenches tell at a glance if the valve is open or closed.



FRACTIONATING These Rockwell-Nordstrom plug valves on a light ends fractionating unit can really be depended upon to do the job. Pressure lubrication keeps them ready for instant operation.

To Light Ends

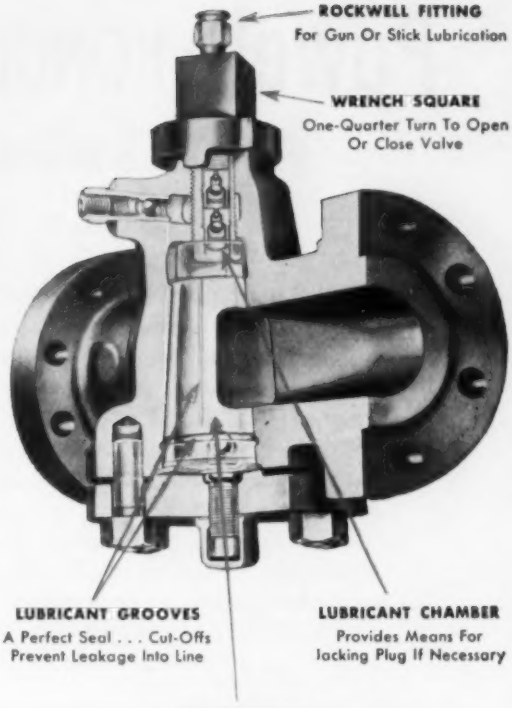
VALVES

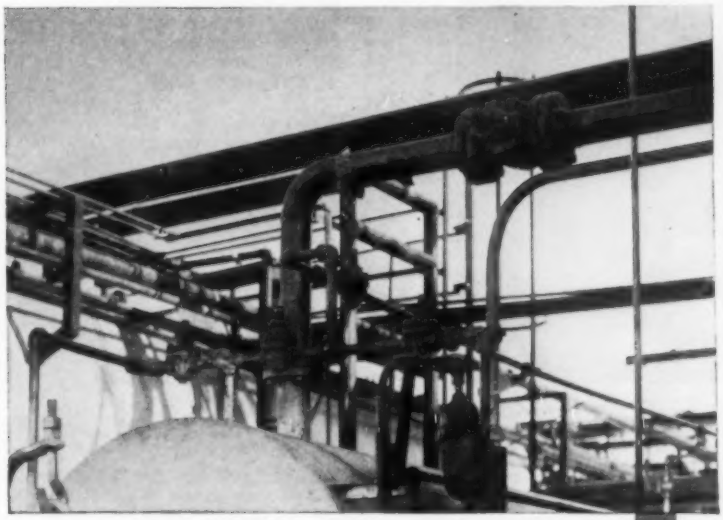
can give you better service, greater efficiency, and lower operating cost than any other valve you've ever used. Write today to Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee:* Peacock Brothers Limited.

ROCKWELL-Nordstrom **VALVES**

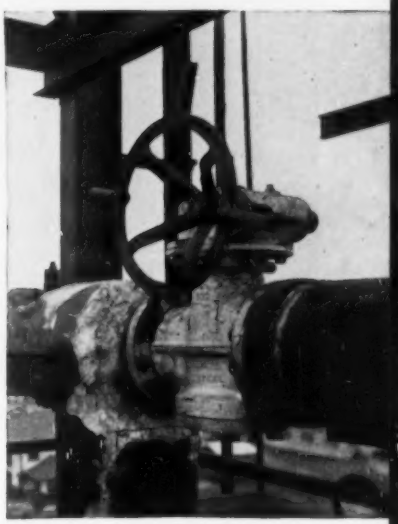
Lubricant-Sealed for Positive Shut-Off

ANOTHER ROCKWELL PRODUCT


ROCKWELL FITTING
For Gun Or Stick Lubrication
WRENCH SQUARE
One-Quarter Turn To Open Or Close Valve
LUBRICANT GROOVES
A Perfect Seal . . . Cut-Offs Prevent Leakage Into Line
LUBRICANT CHAMBER
Provides Means For Jacking Plug If Necessary
TAPERED PLUG
Maximum Strength . . . Perfect Seating . . . Seat Never Exposed



ALKYLATION UNIT Rockwell-Nordstrom valves handle *both* the light ends and the sulphuric acid in an alkylation unit.



POLYMERIZATION UNITS For really tough service this 6 in. hard faced Hypreseal is *the* valve. Used here on the process header manifold to the inlet of catalyst tower on a polymerization unit, this valve will give long-life, trouble-free service.

Powell KONCENTRIK*-FITTED Valves

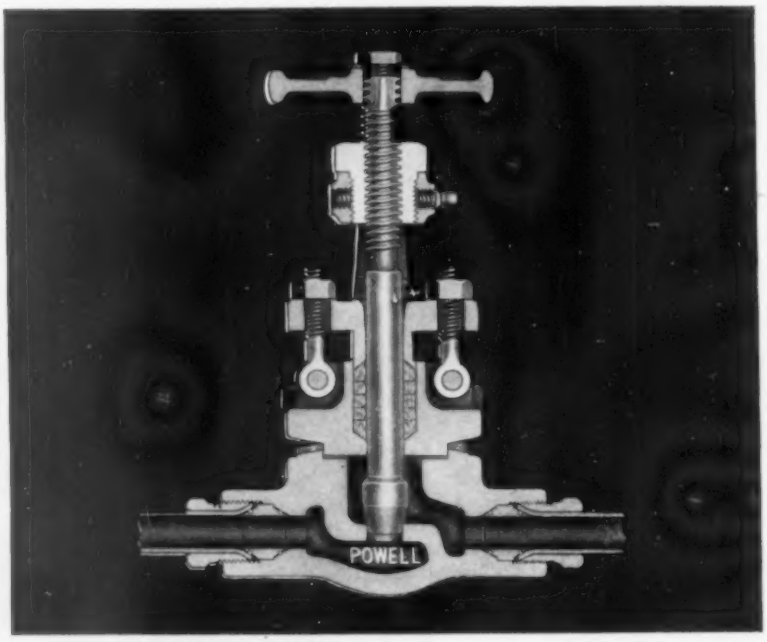
A Powell *exclusive* that eliminates welding, soldering, screwing, or bolting of valves and tubing.

Powell Koncentrik-Fitted Valves provide a positive leakproof connection of valve and tubing. The ends of the valves are lengthened and threaded on the inside to accommodate the patented Koncentrik Full Floating Seat and Tube Nut, as well as the tubing. The tighter the Tube Nut is pulled up, the tighter the seal.

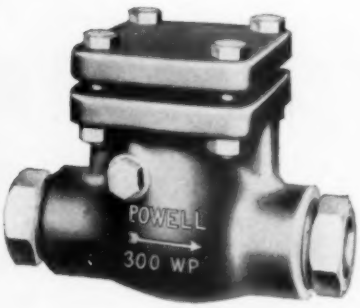
Powell Koncentrik-Fitted Valves are especially adapted for instrument lines and for installations requiring thin wall tubing such as Schedule No. 5 or 10.

Available through distributors in principal cities in Stainless Steel alloys (304, 316 and 20), Monel Metal, Nickel and Aluminum; and in a wide variety of types—Globe, Gate, Check, Needle and "Y" Valves. On problems or for descriptive illustrated circular, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

KONCENTRIK-FITTED 200-POUND STAINLESS STEEL GATE VALVE *(Fig. 1832-K)*. Screw-in bonnet, inside screw rising stem. Solid wedges regularly furnished; split wedges on special order. For corrosion-resistant tubing up to 1" O.D.



KONCENTRIK-FITTED 300-POUND STAINLESS STEEL GLOBE VALVE *(Fig. 2446-K-Sectional)*. Bolted bonnet; outside screw stem and yoke. Stem rises through bushing in upper yoke.



KONCENTRIK-FITTED 300-POUND STAINLESS STEEL SWING CHECK VALVE *(Fig. 2345-K)*. Bolted cap. Metal or Teflon (on order) discs are hung on a 5° angle. For corrosion-resistant tubing up to 1" O.D.

**Trade Mark Reg. U. S. Pat. Off.*

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves 108th year

(To obtain more data on advertised products see page 1112)

Now, for a new high in catalyst utilization!

three new grades of Synthetic Fluid Cracking Catalyst

covering all fluid cracking unit requirements—

for fluid units with

low linear gas velocities
adequate dust disengaging space
excellent cyclone and Cottrell efficiency
low bed density needs

Aerocat® 50/60
(Light)

low apparent bulk density
low average particle size
33% below 30 microns
only 8% above 80 microns

for fluid units with

moderate to high linear gas velocities
adequate catalyst recovery

Aerocat 60/70
(Intermediate)

well-balanced particle size distribution
in 30 to 80 micron range
7% below 30 microns
24% above 80 microns

for fluid units with

high linear gas velocities
moderate disengaging space
limited recovery equipment

Aerocat 75/85
(Narrow)

particle size distribution concentrated
in 30 to 80 micron range
gives best fluidization possible with
narrow cut catalyst
75-85% in 30 to 80 micron range
5-10% below 30 microns
15% above 80 microns

Better catalyst usage, higher fluid cracking efficiency

Based on existing fluid unit needs

To provide refiners a better selection of fluid cracking catalyst grades, we first surveyed the industry to pin-point the type of fluid units operating, and their cracking catalyst requirements.

This study revealed certain basic types of operation. Accordingly, the three new grades of AEROCAT MS catalyst were designed to give optimum catalyst usage under any particular set of conditions.

Offers you better selection for higher cracking efficiency

These new grades of AEROCAT cover the entire range of fluid catalyst requirements. The new grades, representing the widest range available anywhere, will help you select the catalyst best suited to *your* fluid catalytic cracking operation.

You will certainly want to consider these grades in connection with your unit requirements. A data sheet will be mailed on request, or you may call on one of our Technical Representatives.

Aerocat® MS Synthetic Fluid Cracking Catalyst

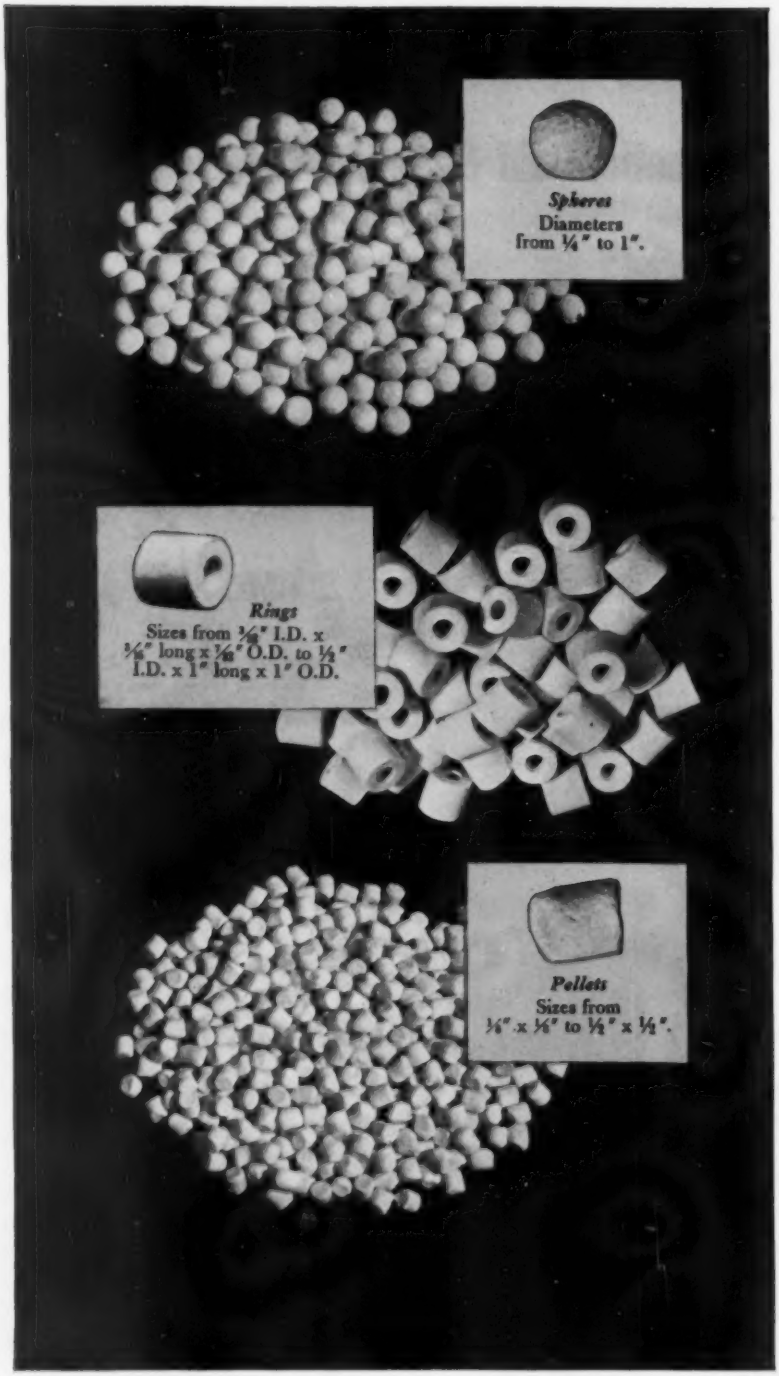
AMERICAN Cyanamid COMPANY

REFINERY CHEMICALS DEPARTMENT

30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

(To obtain more data on advertised products see page 1112)

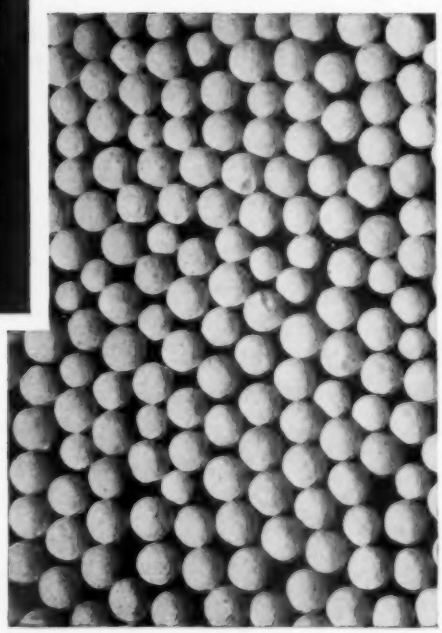


Rx for

Norton catalyst carriers — spheres, pellets and rings — are commercially available in ALUNDUM*, (fused alpha alumina) mixtures. Experimental quantities are available in MAGNORITE*, FUSED STABILIZED ZIRCONIA, CRYSTOLON* and MULLITE.

Norton spherical carriers provide uniform beds in catalytic converters, reducing channeling and pressure drop to a minimum. Medium porosity spheres have porosity ranging from 40% to 44% with a network of open pores on the outside surface only. These are suitable for applications where the carrier is coated with a catalyst. High porosity spheres have porosity ranging from 45% to 49%, with a network of open pores on the outside surface as well as throughout the entire sphere. These are suitable for applications where the carrier is impregnated with a catalyst.

Norton ALUNDUM carriers are proving highly successful in reaction such as those involved in the manufacture of phthalic anhydride, maleic anhydride and oxidation of ethylene. Containing 77% to 89% alumina, they are outstanding for chemical stability and resistance to abrasion and erosion. Write for Bulletin #7, containing additional data on ALUNDUM catalyst carriers.



Norton heat exchange pebbles are made of ALUNDUM. Because of their high alumina content (over 95%) they are ideally suited for pebble type heaters, where they are important as the heat-transfer medium, whether oxidizing or reducing conditions are encountered.

Their ability to withstand abrasion, impact and repeated heating and cooling makes them ideal for heat exchange beds of either the static or moving type. Their high refractoriness prevents softening or incipient fusion at any point in the upper bed. This keeps them from "bridging" together and causing stoppages in a moving bed. ALUNDUM heat exchange pebbles are available in ¼, 5/16, ⅜ and ½" diameters.

(To obtain more data on advertised products see page 1112)

higher production... better processing...lower costs

Norton refractories are engineered for top performance — and prescribed for many chemical applications

For your refractory uses, Norton refractory products are *engineered and prescribed* to give you the best possible ℞ — the most effective combination of physical characteristics plus thermal, chemical and electrical properties.

The ℞'s you need to improve and economize your processing are ready for you in this complete, top-quality line. For details, including expert technical aid, call in your Norton Refractories Engineer. Meanwhile, write for the fact-filled bulletins, mentioned in this advertisement, that cover your particular requirements for dependable, money-saving refractories. NORTON COMPANY, 266 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Canada.

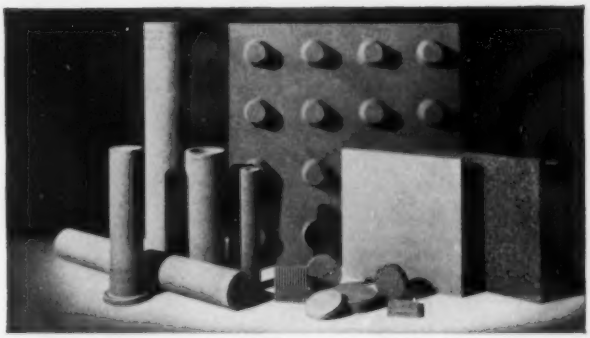
NORTON

REFRACTORIES

Engineered... ℞... Prescribed

Making better products... to make other products better

*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries



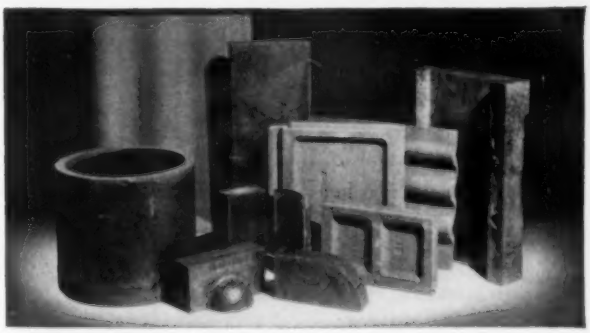
Norton porous mediums come in plates, tubes, discs and diaphragms, engineered to fit your filtering, diffusing or aerating requirements. All have uniform porosity, in the size and open-pore ratio you need. Made of ALUNDUM material that is chemically stable and strong. Thus, their resistance both to acid and alkaline conditions gives them extra long life. Norton seamless porous tubes have the advantage, unusual in tubes, of uniform porosity over their entire area — permitting constant air or liquid pressure and enabling uniform backwashing to do more thorough cleaning.

Typical applications are filtering water or solvents; cutting oils, wine and other liquids; reclaiming cleaning fluids; handling industrial oil wastes. Bulletin No. 140 tells you more about Norton ALUNDUM porous mediums.

Norton electric furnace shapes and laboratory ware

Norton electric furnace refractories — cores, tubes and muffles — are made of ALUNDUM or CRYSTOLON materials. ALUNDUM shapes, composed of 99% pure fused alumina, are characterized by great stability, chemical inertness, excellent thermal conductivity and good electrical insulation qualities. CRYSTOLON shapes, for use under more limited conditions, combine high thermal conductivity with resistance to heat shock. Bulletin No. 458 tells how to construct electrical furnaces for the laboratory.

Norton ALUNDUM laboratory ware, available at your laboratory supply house, offers many properties important to development, experimental or analytical work. It is chemically stable, stands temperatures up to 1900°C and is easy to clean. For filtering, it comes in four degrees of permeability. Bulletin No. 793 gives you the whole story.

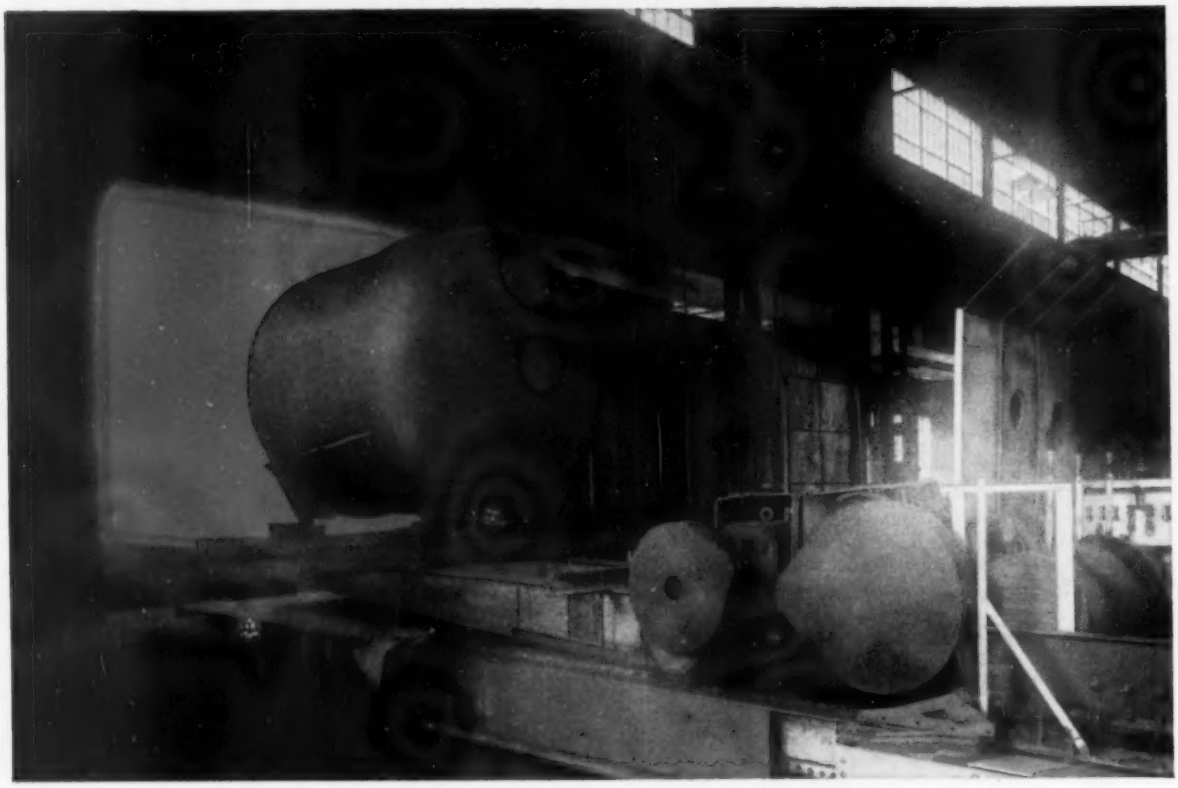


Norton refractory shapes for reaction furnaces come in bricks, plates, tubes and blocks, made of ALUNDUM, CRYSTOLON, MAGNORITE and FUSED STABILIZED ZIRCONIA refractory materials. The development of FUSED STABILIZED ZIRCONIA is a typical example of how Norton aids you in utilizing higher temperatures for greater efficiency and output. Norton was the first to bring this valuable material out of the experimental stage into commercial production. Now it is used in many processes.

No other refractory is so chemically stable at such high temperatures under both oxidizing and reducing conditions. In gas synthetic processes, furnaces lined with it have withstood temperatures approaching 4700°F for long periods. Its low thermal conductivity (6.2 BTU in dense shapes at 2000°F) and its high electrical conductivity at high heat are other important properties, all of which are described in Bulletin No. 1409.

Glascote PRODUCTS, INC.

a new **A.O.Smith** subsidiary



Where glass weds steel for corrosive service

Here is good news to chemical engineers who seek dependable equipment for corrosive service.

The long experience of Glascote technicians in designing and fabricating glass-on-steel processing equipment is now combined with the extensive experience and research activities of A. O. Smith in ceramics, metallurgy and welding.

Chemical, petro-chemical, pharmaceutical, plastics and synthetics producers will find this amalgamation of great value to them since corrosion-resistant reactors, receivers, condensers, storage tanks and transport tanks have long been produced by Glascote Products, Inc. And A. O. Smith Corporation is the world's largest manufacturer of glass-lined steel products, including storage and fermenting tanks for the Brewing Industry, *Permaglas* water heaters for the home and *Harvestore* crop storage structures for farms and commercial applications. In addition, A. O. Smith manufactures high-temperature, high-pressure, corrosion-resistant vessels for the Processing Industries.

Look to Glascote and A. O. Smith for the corrosion-resistant and processing equipment you need . . . in standard or custom designs.

Glascote
PRODUCTS, INC.

CLEVELAND 17, OHIO
A subsidiary of A. O. Smith Corporation

Sales offices or agents in Principal Cities
Export Sales: A. O. Smith Corporation,
International Division,
Milwaukee 1, Wisconsin

When something's got to give
to compensate for expansion,
contraction, vibration, rotation or strain,
in your piping system or equipment,
it will be far, far better for you
if the "something" that gives
is a Zallea Expansion Joint
and not your expensive piping.
Since piping damage usually
means down-time, it pays
to provide positive, over-all protection.

The expansion joints illustrated,
duo-equalizing, hinged, and universal,
are just a few of the Zallea family
of expansion joints available
to help solve your piping problems.

Regardless of piping movement,
whether axial, lateral, rotational,
etc., Zallea already has, or will
design, an expansion joint to absorb it.
For information on standard types,
request Bulletin 351. For consultation
on special problems, ask us to
have our representative call.

Zallea
expansion joints

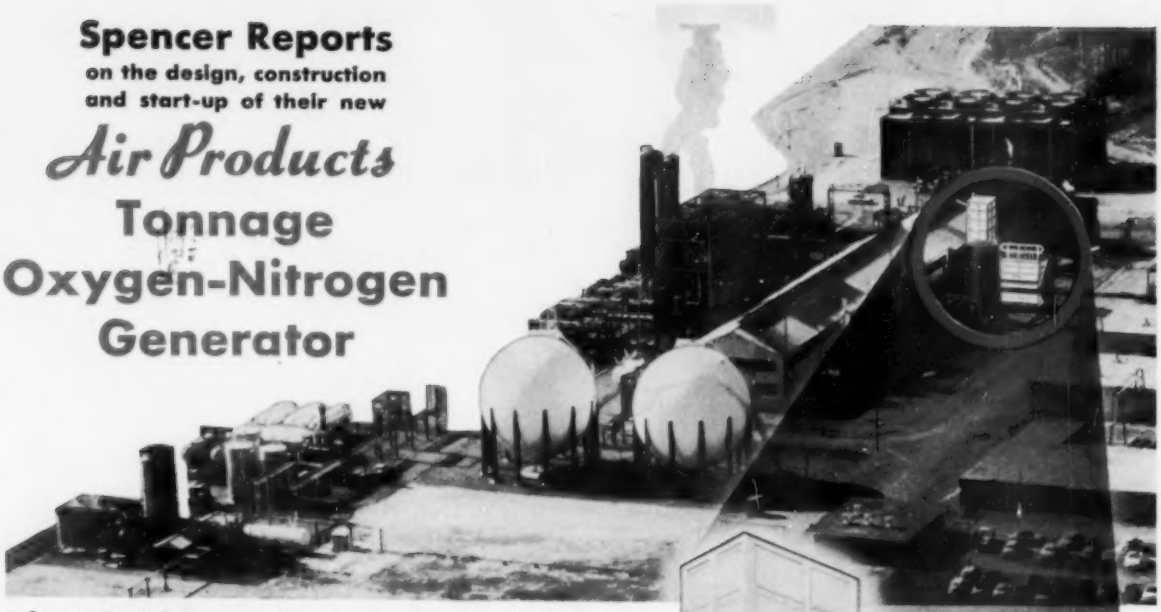
ZALLEA BROTHERS, 822 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

Spencer Reports

on the design, construction and start-up of their new

Air Products Tonnage Oxygen-Nitrogen Generator



• Spencer Chemical Company's New Ammonia Plant at Vicksburg, Miss.

Spencer Chemical Company
DWIGHT BUILDING
Kansas City 5, Missouri

Mr. Leonard Pool, President
Air Products, Incorporated
P. O. Box 538
Allentown, Pennsylvania

Dear Mr. Pool:

"...I want to express for the entire Spencer Company our appreciation for the strong team of technical men that you have sent down to assist with the erection of the Air Plant and put it through its initial paces. They are not only technical experts, but have exhibited a fine attitude towards working together with our men."

"...It is particularly gratifying to us to see that the expanders and liquid oxygen pumps are both performing excellently."

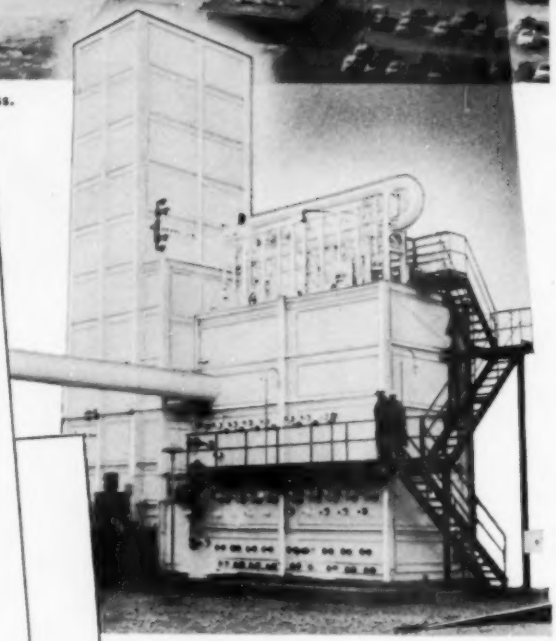
Very truly yours,

R. F. Brown
General Works Manager

"...I should like again to compliment you and your organization on the fine manner in which you cooperated with all of our Spencer people during the construction and start-up of the Vicksburg Unit. To my knowledge, it was a relationship which left little or nothing to be desired."

Very truly yours,

B. M. Kern
Chief Engineer



For this kind of service from inquiry to start-up . . . and on through the years of operation . . . entrust your low-temperature processing work to *Air Products*. If your project calls for a tonnage or high-purity oxygen and/or nitrogen generator . . . large or small hydrogen purification plant . . . a plant for separation of coke oven gas, refinery fluids . . . call us in. We can provide cost data, process design, apparatus design and manufacture . . . whatever you require. *Air Products, Incorporated, Dept. L, Box 538, Allentown, Pa.*

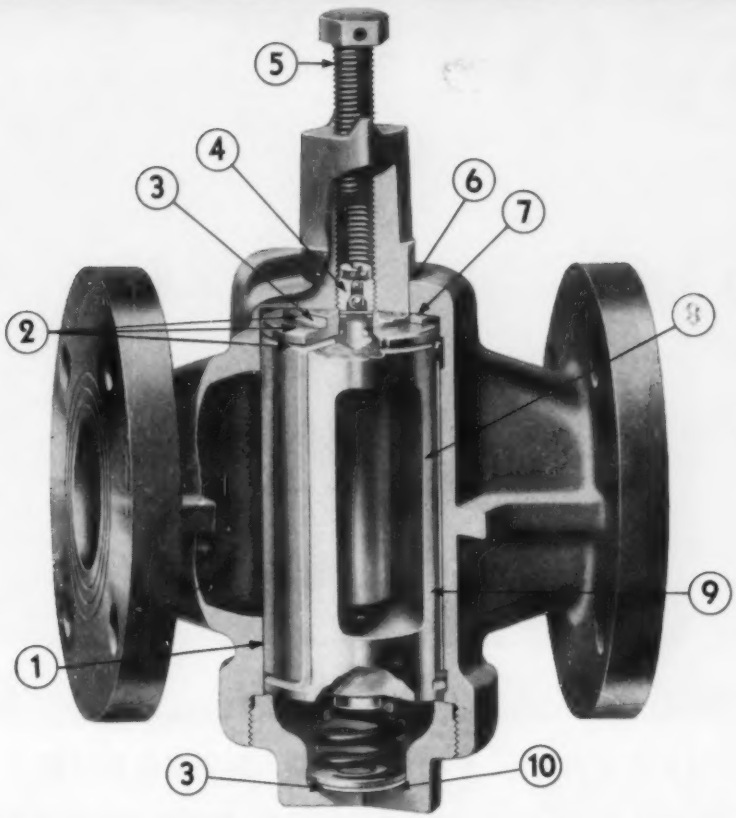
Send for 36-page brochure, "Low-Temperature Processing"

Air Products INCORPORATED

Specialists in Low-Temperature Processing

NEW HOMESTEAD
lubricated plug valve

(Patents Pending)



with features that guarantee longer, low-cost service

. . . and really low priced!

1. Close tolerance between sealing surfaces—extra long valve life—less lubricant needed.
2. Triple head seal—two rings of lubricant, and a teflon sealing ring prevent leakage.
3. Plug floated on teflon rings—low friction—extra ease of turning.
4. Leakproof double-ball and lubricant sealed check valve—no springs—no maintenance.
5. Full-threaded screw prevents dirt from being forced into lubricant system.
6. Extruded lubricant shows when system is full. Minimum contamination of line fluids.
7. Reinforced teflon seal—no cold flow—continuous positive seal.
8. 100% pipe area or venturi patterns.
9. High pressure lubricant system forces chemical seal over all seating surfaces. Full lubricant seal around ports.
10. Spring torsional stress relieved by teflon washer—less maintenance—longer life.
11. No mechanical adjustments—human error minimized.
12. Two lubricants handle most all services.

Mail coupon for catalog and complete details.

HOMESTEAD VALVE MANUFACTURING CO.

Makers of Cam-Seald and Lever-Seald Plug Valves, Hydraulic Operating Valves, Boiler Blow-Off Valves, Hypressure Jenny Steam Cleaners and Compounds.

"Serving Since 1892" — P.O. Box 43, Coraopolis, Pa. — 200 Sales Representatives

Without obligation, please send Reference Book 39 Section 5 and prices on Homestead Lubricated Plug Valves.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Extra STRENGTH... *Added* SAFETY... *Sealed* for SERVICE

MIDVALE FORGED PRESSURE VESSELS

Product-Converter
Body Diameter-55″
Inside Diameter-40″
Ring Diameter-68¼″
Overall Length-37′—2-15/16″
Operating Pressure-5,625 P.S.I.
Tensile Strength-50,000 P.S.I.
Shipping Weight-144,240 lbs.

From the time this converter was on the drawing boards at Midvale until it was ready to roll on this flatcar strength and service was the keynote. Veteran steel makers melted the right alloy steel. Skilled hands forged toughness into it. Modern sonic, hydrostatic, strain gauge and X-Ray tests assured unfailing performance.

This converter is not unusual for Midvale—not the largest, not the smallest we make. A 268,000 pound octagonal ingot was forged and machined to an overall length of more than 37 feet with a body diameter of 55 inches. Hydrostatically tested at 8,450 psi. for working pressures of 5,625 psi. . . . yield strength of 50,000 pounds.

Midvale engineers, working with those of the chemical company, designed this converter to fit the specific needs of the plant. At one end of the vessel with full diameter opening the head is held on by a screwed yoke. Sealing is effected by a triangular-shaped copper gasket, sealing force attained by set screws. The other end of the vessel is closed down to about one-half the main diameter, bolted on and a self-sealing steel gasket of the "delta" type used.

Converters, autoclaves, separators, high-pressure accumulators, reactors . . . Midvale can forge them for your plant to meet specific processing requirements of pressure and capacity. Let our engineers work with you from initial design to final installation.

THE MIDVALE COMPANY- Nicetown, Philadelphia 40, Pa.
Offices: New York, Chicago, Pittsburgh, Washington, Cleveland, San Francisco

MIDVALE

FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

ARE YOU PAINTING WITH APPLESAUCE?

Corrosive fumes and gases play havoc with "unprotected" structural steel walls and ceilings. But the selection of a satisfactory protective coating isn't always easy. A coating that adequately protects against fume "A" may fail in a week against fume "B."

Corrosion engineers know there is no "all purpose" protective coating. Wisely they steer clear of products whose makers claim *universal* "acid and alkali" resistance. They have learned through bitter experience that all too frequently they end up "painting with applesauce."

The fact that Tygon Paint — first marketed in 1939 — has grown increasingly popular with corrosion engineers, stems from two things:

1. IT IS A GOOD PROTECTIVE COATING
2. WE'RE NOT AFRAID TO ADMIT ITS LIMITATIONS

Used as it should be used and under conditions for which it is suitable, Tygon Paint will out-perform and outlast practically any coating on the market. Fifteen years have proved it.

WRITE FOR THIS FREE BOOKLET

Bulletin 750 tells how and where to use Tygon Paint . . . how to make sure you're going to get adequate protection at minimum cost. Address Dept. BW354, The U. S. Stoneware Co., Plastics & Synthetics Division, Akron 9, Ohio.

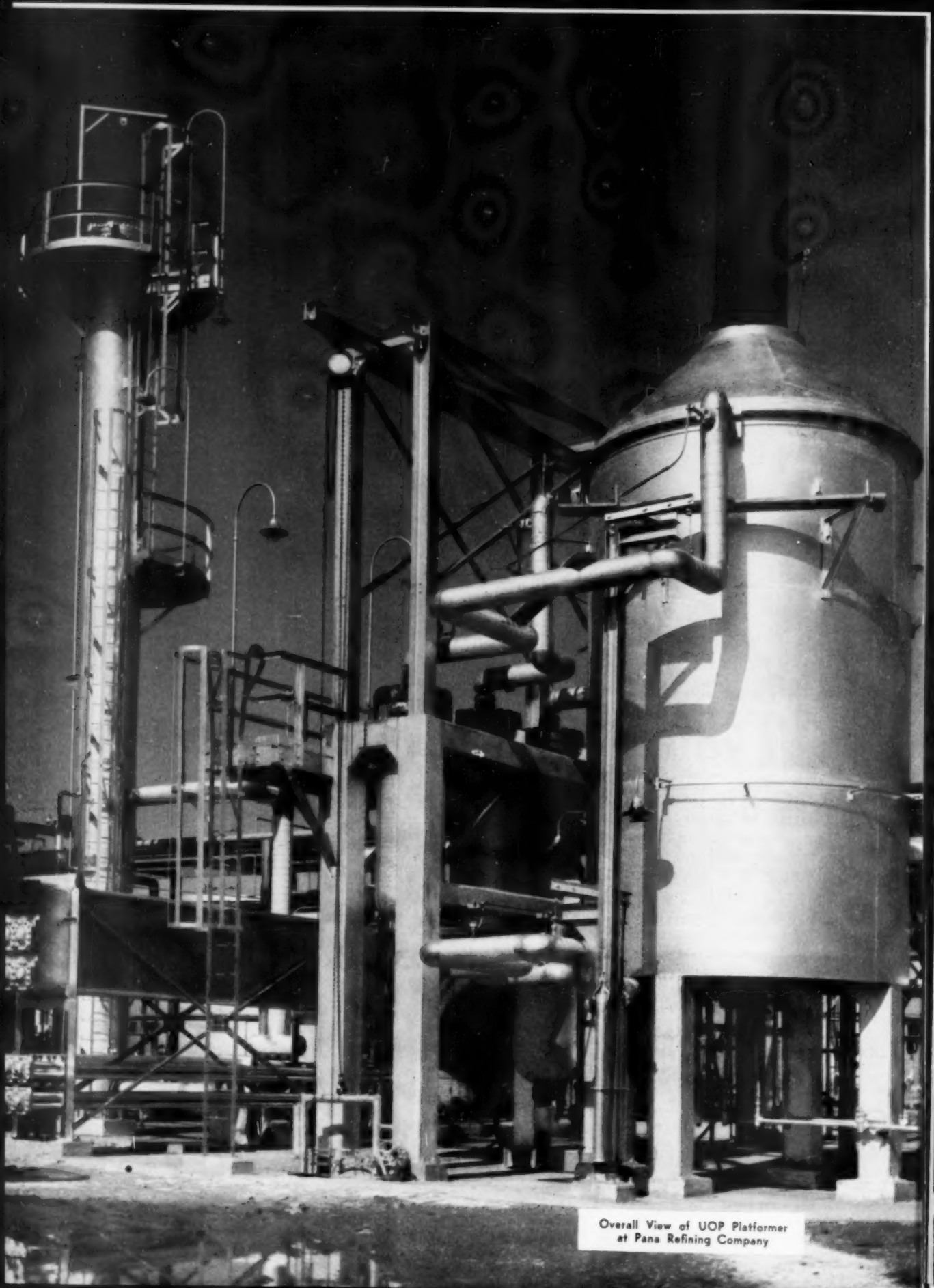
PRODUCT OF

U.S. STONEWARE

Akron 9, Ohio

Plastics and Synthetics Division

335-D



Overall View of UOP Platformer
at Pana Refining Company

(Advertisement)

Platformer Helps Pana Achieve High Quality Goal

By R. H. Carroll, Manager
Pana Refining Company
Division of
Illinois Farm Supply Company

THE 650 B/SD UOP Platforming unit which went on stream at our refinery last October has enabled us to achieve a long-sought goal — that of making the best motor fuel known to the petroleum refining industry.

R. H. Carroll

Currently, our Platformer is consistently producing a stabilized Platformate having an octane number of 94 F-1 leaded. It is the first Platformer in commercial operation in the state of Illinois to be devoted exclusively to the production of motor fuel.

Our refinery is owned by the Illinois Farm Supply Company, and serves as one of the sources of supply of petroleum products distributed by the Illinois Farm Supply Company to its member company county service companies. These county organizations in turn distribute gasolines, greases, lubricants, burner oils, and Diesel fuels to Illinois farmers.

Products Supply Supplemented

Illinois Farm Supply purchased Pana Refining Company in the spring of 1948 in order to supplement its supply of petroleum products to its members. The refinery has been gradually modernized, with the installation of the UOP Platforming unit being the latest step. In addition to a UOP crude unit, we also have a UOP catalytic polymerization plant, and the entire refinery is under a UOP service agreement.

The Platformer is unique in that it has no feed preparation unit. The charge, which is essentially 225° to 400° F. boiling range naphtha, is removed from the UOP crude unit fractionator as a sidecut and goes directly to a charge surge drum. The end point and the over-all boiling range of the charge material is controlled by regulating the withdrawal rate of the naphtha and the end point of the lighter fraction produced from this tower.

The naphtha charge, together with the hydrogen recycle stream, enters the effluent heat exchanger before passing through the three-coil vertical heater and the three reactors.

The effluent from the reactor is split into two streams. One stream is used to supply heat to the stabilizer reboiler, then it unites with the other stream, and the combined stream passes through the heat exchanger, reactor products cooler and then to the products separator. Platformate is pressured out of the separator into the stabilizing column, where it is stabilized and sent to blending tanks.

Performs Two-Fold Duty

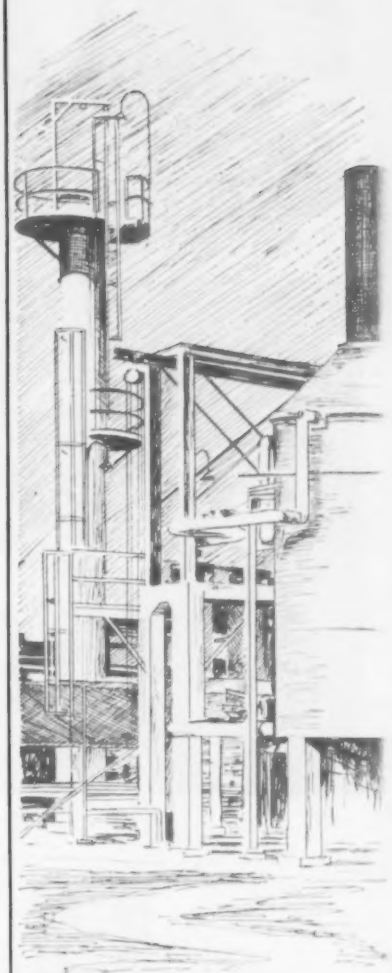
The reactor products separator performs a two-fold duty: (1) Of separating hydrogen, and (2) Of furnishing a suction tank for the hydrogen gas compressor, which takes suction on the dry side of the separator, then discharges the hydrogen back through the heaters with the naphtha charge. Excess hydrogen from the separator is used as fuel gas in the charge heater.

We were able to eliminate a feed preparation unit for the Platformer because investigation showed that the crude unit fractionator had the degree of fractionation necessary for preparation of feed stock without rerunning. The refinery at one time produced naphtha for a paint manufacturer that was essentially in the 300° to 400° F. boiling range, so we were reasonably certain that the crude fractionator could handle the type of naphtha sidecut for the Platforming unit.

By making minor revisions in the crude unit fractionator, we were able to effect considerable savings not only in the initial investment of the Platformer, but in operating costs as well.

Universal Oil Products Company engineers did the process design for the Platformer, while Procon Incorporated handled the mechanical design and drafting, purchasing and construction.

We are more than satisfied with the results obtained from our Platforming unit. It has enabled us to make the best quality balanced product at a reasonable investment in equipment, and is assuring Illinois Farm Supply Company's member companies of a constant supply of superior motor fuel.



650 B/SD
UOP PLATFORMER
PRODUCING
94 OCTANE
MOTOR FUEL
AT PANA, ILLINOIS

designed, engineered and licensed by

UNIVERSAL
OIL PRODUCTS
COMPANY

30 ALGONQUIN ROAD,
DES PLAINES, ILL., U. S. A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service
Protects Your Investment

3000 impulses help keep mid-west refinery "on stream"

THIS big refinery at Lawrenceville, Ill.—like a lot of other important refineries — uses Yarway Impulse Steam Traps.

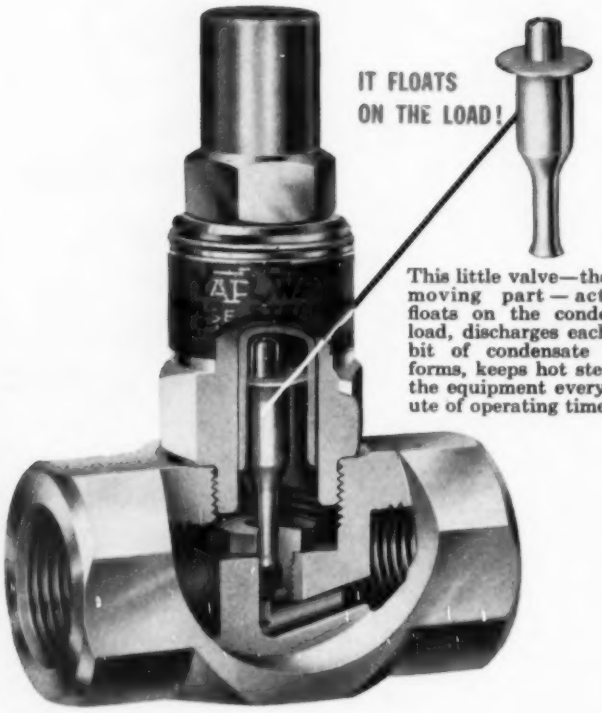
Over 3000 Yarway Impulse Traps are installed on tracer lines and for draining steam headers.

Popular features of the Yarway Impulse Steam Trap are its ability to get equipment *hot in a hurry*—and keep it hot! . . . also its small, handy size—fits in easily in any location; its stainless steel body and working parts; quick installation; easy maintenance; low initial cost.

Another advantage — IMMEDIATE DELIVERY from 250 local distributors, plus quick service from nearby Yarway field engineers.

More than 900,000 Yarway Impulse Steam Traps have been sold. For a free Steam Trap Selector, write . . .

YARNALL-WARING COMPANY
153 Mermaid Ave., Philadelphia 18, Pa.



This little valve—the only moving part — actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

YARWAY impulse® steam trap

(To obtain more data on advertised products see page 1112)

Here's Aluminum Chloride

in the RIGHT SIZE for your use

Most often, a particular process using aluminum chloride, anhydrous, works best with a selected particle size.

We have taken technical liberties in this picture (exposing aluminum chloride to the air) to show you the *four* sizes available from Hooker.

Extra work of screening isn't necessary when you specify Hooker aluminum chloride. The four sizes give you a choice that will meet just about every process requirement:

1. *Extra fine grind* is unscreened, with 90 to 95% passing 40 mesh.
2. *Fine grind* is unscreened, practically all passing 20 mesh.
3. *Coarse grind* is unscreened, 1 mesh and finer. It contains 25 to 35% finer than 20 mesh.
4. *Coarse screened* is the same as coarse grind (No. 3), but is screened to remove 20 mesh and finer.

Before re-ordering your requirements, get the facts on Hooker aluminum chloride. For technical data, just phone the nearest Hooker office listed below, or mail the coupon today.

Need other chlorides? This is only one of several metal chlorides available from Hooker. Chlorinated organics and inorganics are specialties with us; we've been making them for more than 30 years. If you need a special chlorine-containing compound in quantity, we may be able to produce it for you economically. To find out quickly, just phone the nearest Hooker office or write us today.

FOR FAST SERVICE, PHONE:

CHICAGO ..... CEntral 6-1311
LOS ANGELES ..... NEvada 6-3826
NEW YORK ..... MUrray Hill 2-2500
NIAGARA FALLS 6655
TACOMA ..... BRoadway 1215

HOOKER ELECTROCHEMICAL COMPANY,
4713 Buffalo Ave., Niagara Falls, N. Y.

Please send:

☐ Data sheet on Hooker aluminum chloride, anhydrous
☐ Bulletin 100 describing Hooker products and services

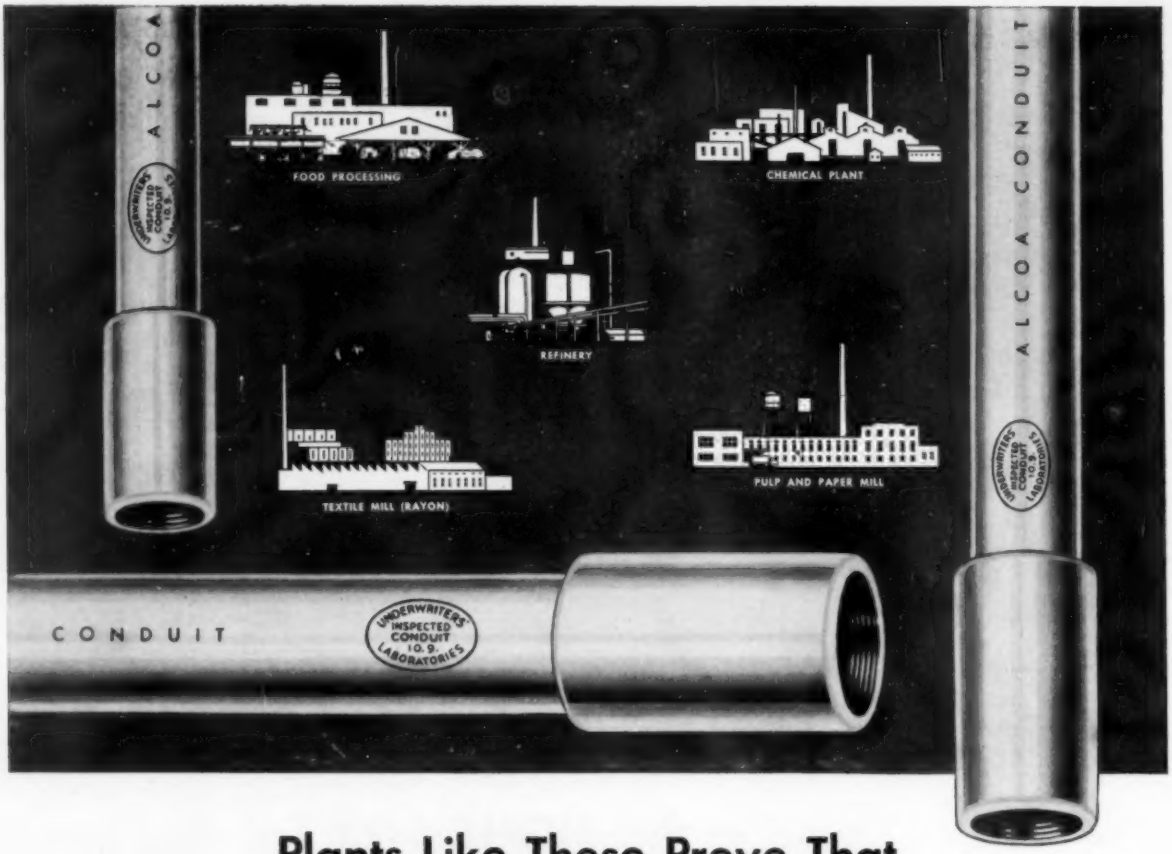
Name..... Title.....
Company..... Address.....
City..... Zone..... State.....

HOOKER CHEMICALS

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES



Plants Like These Prove That ALCOA® ALUMINUM RIGID CONDUIT Is the Lowest Cost Corrosion-Resistant Conduit

Alcoa Aluminum Rigid Conduit, especially resistant to industrial atmospheres that often attack other metals, costs less than any other corrosion-resistant conduit. The excellent performance of aluminum conduit in corrosive conditions means lower maintenance costs and less frequent replacement.

In addition, Alcoa Aluminum Rigid Conduit is nonmagnetic, lowers voltage drop, eliminates overcrowding of terminal enclosures and simplifies the installation of electrical equipment having widely spaced terminals.

Alcoa Aluminum Rigid Conduit reduces handling, fabricating and installation costs. It is only about one-third the weight of the same size in steel. A 10′ length of the 4″ size weighs only 33 pounds and can easily be handled by one man.

Alcoa Aluminum Rigid Conduit is readily available. Approved by Underwriters' Laboratories, Inc., each piece bears their label. Call your local Alcoa sales office, listed under "Aluminum" in your classified directory. ALUMINUM COMPANY OF AMERICA, 2093-G Alcoa Building, Pittsburgh 19, Pa.

For complete information write for Alcoa's new booklet, *Alcoa Aluminum Electrical Rigid Conduit.*

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Why is "Lead" used to control Sulphuric Acid Corrosion?

For centuries "Vitriol" was hard to harness.

But in 1746, Roebuck of Birmingham found how to tame this workhorse of the chemical industry. He used lead.

Lead is still the first metal to look to for control of sulphuric acid corrosion. It's basic in producing H_2SO_4. It's basic in handling H_2SO_4. It's basic in concentration, recovery and storage of H_2SO_4.

Lead should come first to mind in the control of corrosives because:

1 **Lead makes and wears its own protective armor.** Repairs it, too. In contact with H_2SO_4 (and many other acids) it makes for itself an impervious, insoluble, self-mending coating which only an abnormal condition destroys.

2 **Lead cooperates when it is fabricated.** No common metal is easier to work. Even in the field you can easily melt and cast it . . . mold and shape it . . . cut or form it. You can "burn" (weld) lead to lead with simple equipment. You can bond it to steel or copper.

3 **Lead is economical and available.** Its cost per pound is low. It costs little to maintain. When its application has run its course, lead has high salvage value . . . often a substantial percentage of original metal cost.

WHAT GOES FOR LEAD AND H_2SO_4 GOES FOR LEAD AND HUNDREDS OF OTHER CORROSIVES

When you think of Lead . . . think of National Lead

National Lead puts lead in your hands in all the grades and forms you may require. National Lead provides all common mill shapes and sizes and forms . . . sheet, pipe, fittings, valves. Or you can have National Lead "tailor-make" lead equipment for you.

So put National Lead first in your thinking when you want to combat corrosion. Call on National Lead for technical assistance. Ask for a copy of the new booklet on "Chemical Lead Products."

National Lead Company

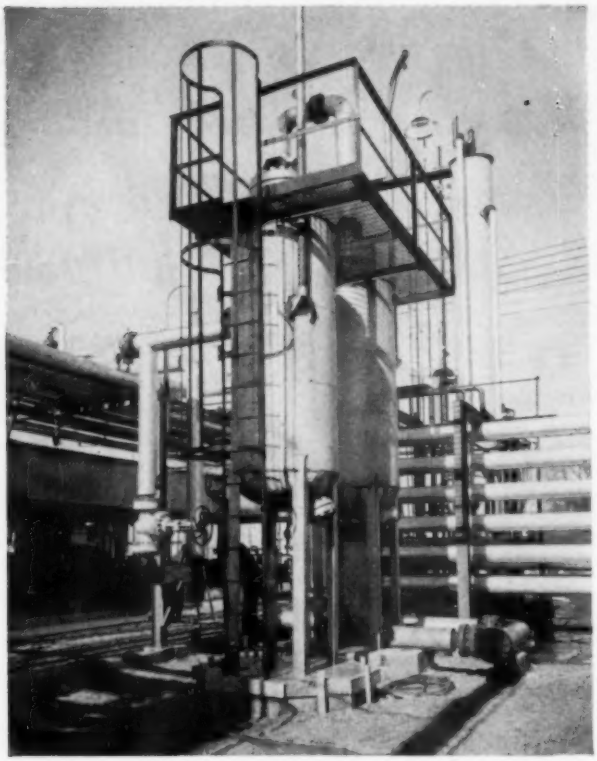
New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited).

*Reg. U.S. Pat. Off.

INTERESTED IN

UNIFINING

FOR DESULFURIZATION AND UPGRADING



• First Commercial Unifiner
United Refining Co.
Warren, Pennsylvania

UNIFINING should be of particular interest to all operators of catalytic reformers which produce by-product hydrogen.

• Harshaw is the exclusive producer of the Union Oil Company of California cobalt-molybdate catalyst used in the recently announced "Unifining" desulfurization and upgrading process. This rugged, commercially proven catalyst is supplied in the form of cylindrical tablets conforming to rigid physical and chemical specifications established by Harshaw and Union Oil Company of California. Stability at high temperatures permits repeated regenerations if and when necessary.

Please contact Harshaw for further information on this catalyst.

HARSHAW

THE HARSHAW CHEMICAL CO.

1945 East 97th Street, Cleveland 6, Ohio

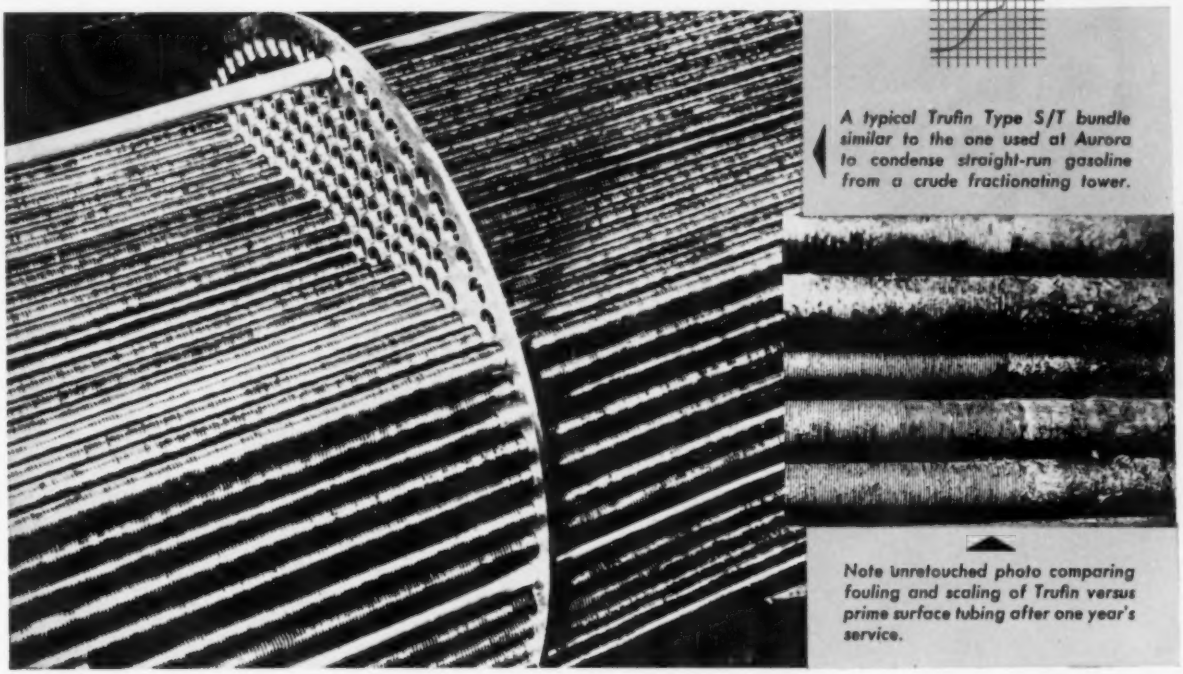
Chicago 32, Illinois • Cincinnati 13, Ohio • Detroit 28, Michigan • Houston 11, Texas
Los Angeles 22, California • New York 17, N. Y. • Philadelphia 48, Pennsylvania
Pittsburgh 22, Pennsylvania

(To obtain more data on advertised products see page 1112)

How RETUBING WITH Wolverine Trufin*
TYPE S/T

BOOSTED CONDENSING CAPACITY

at AURORA GASOLINE COMPANY



A typical Trufin Type S/T bundle similar to the one used at Aurora to condense straight-run gasoline from a crude fractionating tower.

Note unretouched photo comparing fouling and scaling of Trufin versus prime surface tubing after one year's service.

Increased production of an existing "stand-by" condenser at Aurora Gasoline Company, Detroit, Michigan called for the installation of additional condensing surface area. The stand-by unit—a small, prime-surface tube unit—was not originally designed for this kind of service.

Wolverine's Field Engineering Service suggested that the smaller condenser be retubed with Trufin Type S/T . . . an integral finned tube designed primarily for shell and tube units. Trufin was a natural choice simply because it packs so much condensing surface in a small area.

As a result, the stand-by unit—when retubed with Trufin—operated at the same heat duty as the larger prime-surface condenser originally designed for this service.

Full advantages of Wolverine Trufin are realized in units like Aurora's. When additional capacity or increased surface area is required—where costs must be reduced—Trufin can do an outstanding job.

Remember: Trufin is all one piece! Fins are extruded right from the tube wall. Trufin stands up under the shock of vibration, temperature changes, and pressures.

WHAT ABOUT YOU? If you have an under-surfaced heat exchanger—one that requires a bigger punch—you'd do best to consider Trufin, too. It's available in copper, inhibited admiralty, copper-base alloys, aluminum, stainless steel, electric welded steel, bi-metal. Write for your copy of Wolverine's Condenser Tube Book today! WOLVERINE TUBE DIVISION of Calumet & Hecla, Inc., 1441 Central Avenue, Detroit 9, Michigan.

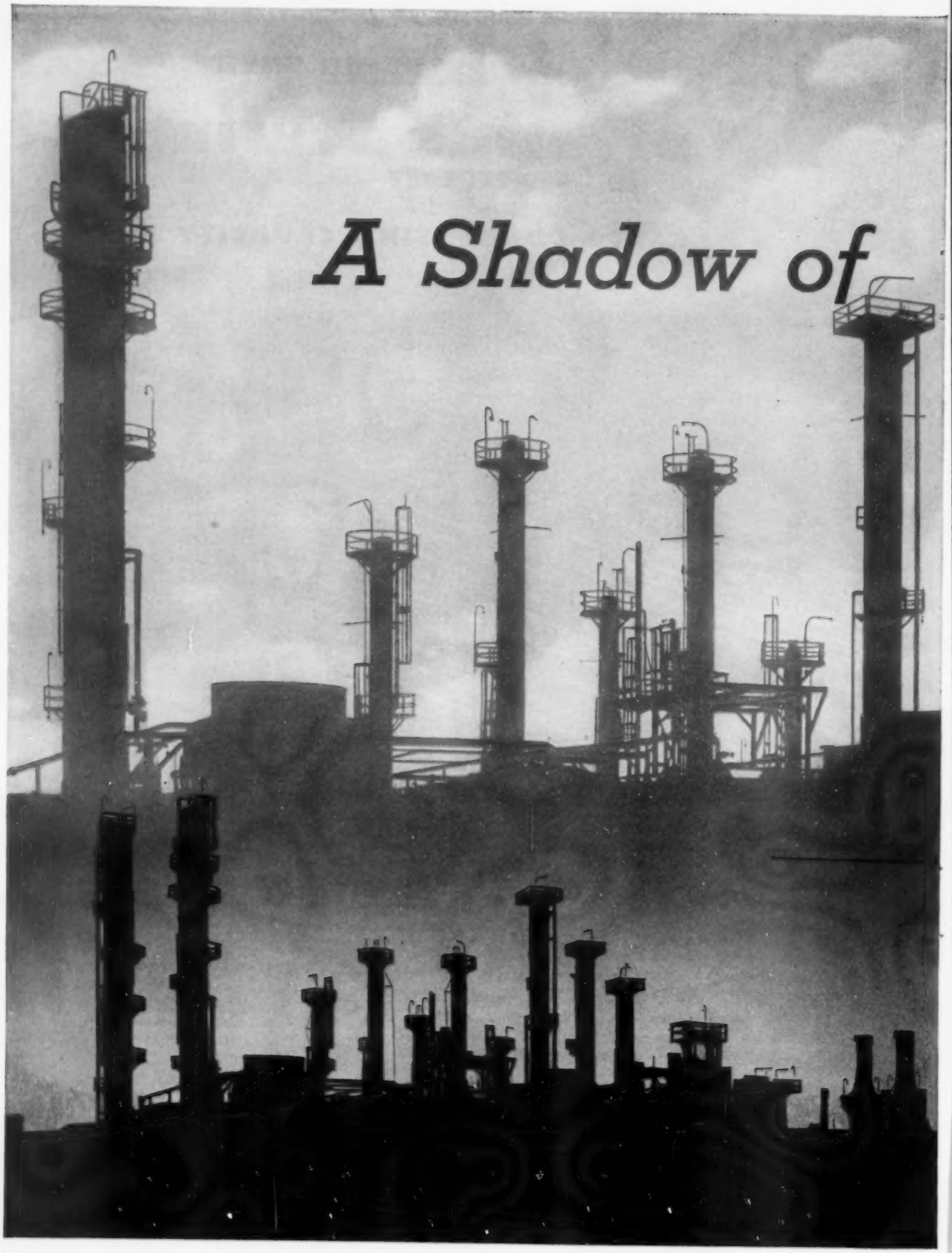
Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

*REG. U.S. PAT. OFF.

EST. 1916

WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK.


A Shadow of

Things Yet to Come

A great deal has happened since the inception of this company four years ago. It has been a time of exceptional growth, progress, achievement.

The broad range of work undertaken includes the simple and the complex . . . complete refineries and auxiliary units . . . crude units and office buildings . . . turnaround operations and laboratories. And the field of operation has expanded to become international in scope, with "Built by Procon" a well-known term even in the more remote parts of the world.

We are proud of the men in our organization whose talents, experience and unbounded energy have made these achievements possible.

But we are even more conscious of, and grateful for, the confidence placed in us which, from the very start, has been so clearly evidenced by all those whom we have served.

The accomplishments of these past four years . . . great as they seem to this young business . . . will, we are confident, prove to be but a shadow of things yet to come.

PROCON *Incorporated*

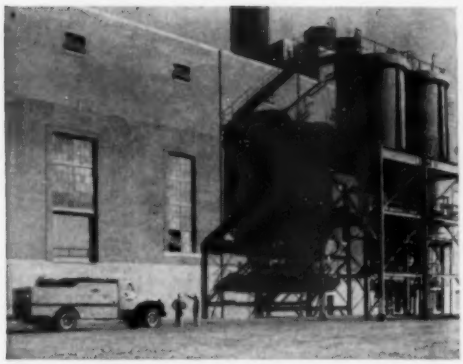
PROCESS CONSTRUCTION

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U. S. A.

IN CANADA | PROCON (CANADA) LIMITED
40 ADVANCE ROAD
TORONTO 18, ONTARIO

IN ENGLAND | PROCON (GREAT BRITAIN) LIMITED
112 STRAND, LONDON, W. C. 2

300,000 PPH BOILER CLEANED CHEMICALLY IN ONE DAY!



Dowell engineers bring solvents to the job in truck-mounted tanks, along with all pumping and control equipment. They apply the chemicals as necessary—by filling, spraying, jetting, cascading or vaporizing.

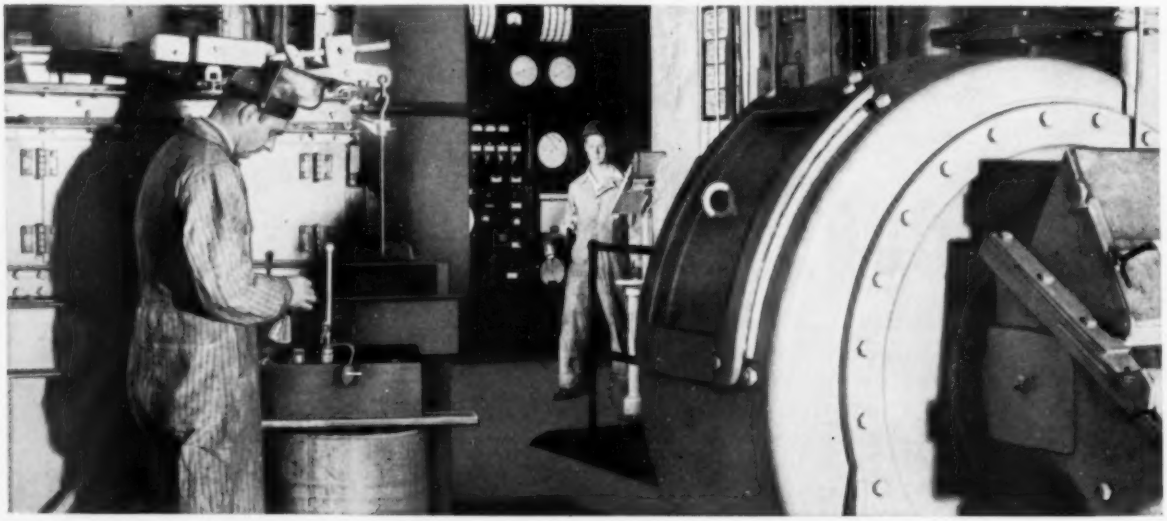
Comparative cases showed DOWELL cleaning took less time . . . removed more scale than mechanical methods

This is a case history on a 300,000 pound per hour boiler in a refinery. A routine inspection showed that iron oxide and silicate scale fouled the tubes. Dowell engineers cleaned the boiler with chemical solvents in less than 22 hours.

Dowell chemical cleaning is the standard method of removing deposits from boilers in this plant. Comparative tests showed that the chemical method was both faster and more thorough than the mechanical means previously used. The operator was surprised at the relatively large amounts of scale and sludge removed by chemical cleaning. Dowell has cleaned 25 of the 27 boilers in this plant. Several have been cleaned as many as three times on an annual basis.

Dowell liquid solvents go wherever steam and water flow, reaching surfaces inaccessible to other methods. No special scaffolding is required. *Dismantling and down-time are kept to a minimum.* Often, equipment may be cleaned while in operation.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant—for example, heat exchangers, piping systems, tanks and process towers. For complete information and estimates, call the nearest of more than 130 Dowell offices, or write directly to Dept. G-32, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.



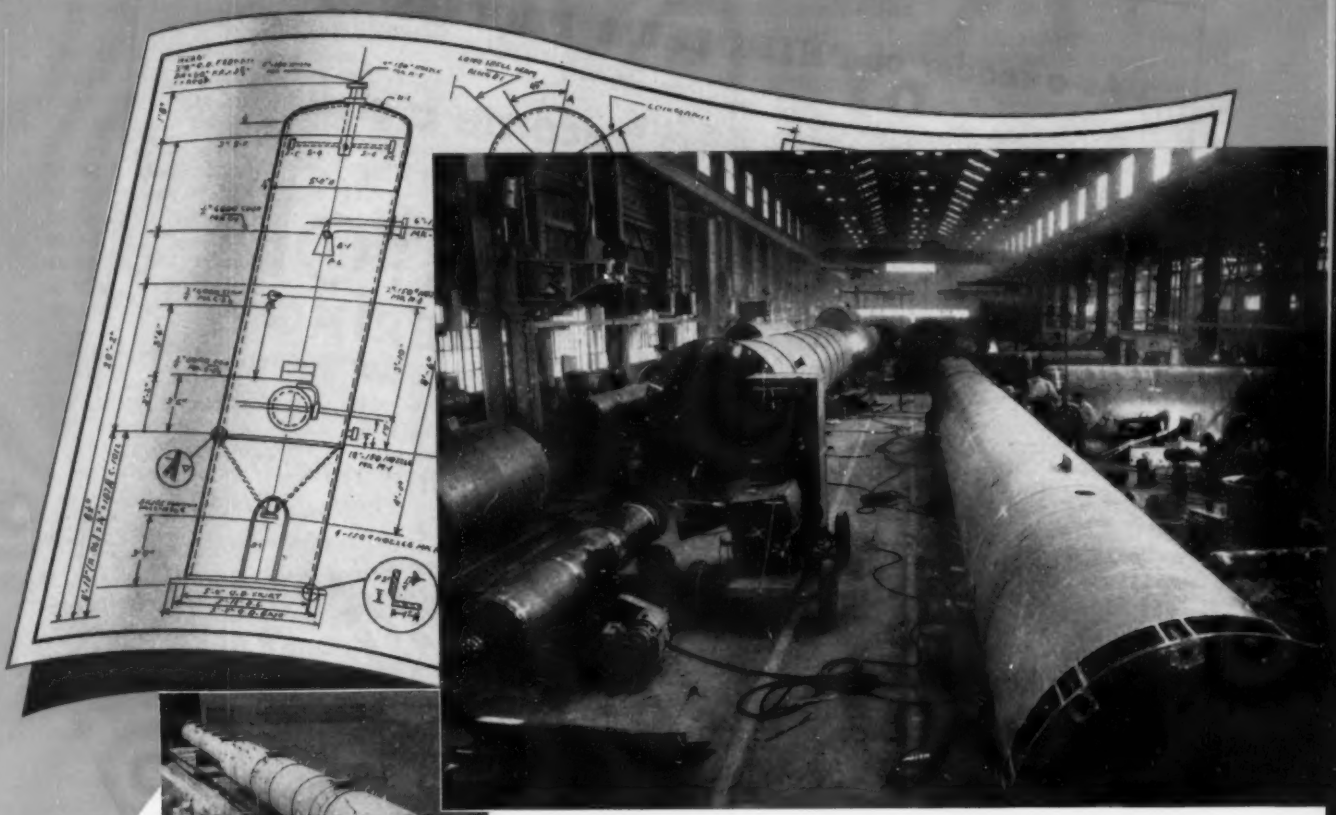
DOWELL SERVICE

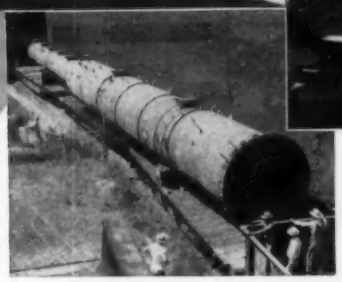
chemical cleaning service for industry

DOWELL

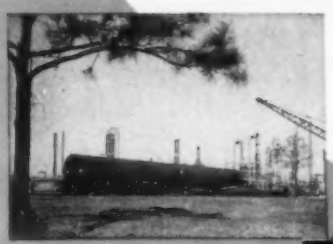
A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

You DESIGN 'Em...We'll BUILD 'Em...





And Deliver 'Em To Your Plant Site Ready For Erection and Installation!



Today's Oil and Gas Processing Industries are demanding ever bigger and more complicated processing equipment and facilities to enable them to meet the challenge of tomorrow's business. A large part of this new equipment must of necessity be custom designed, engineered and fabricated because of its tremendous size, its limited application or its special purpose. Such is true of tanks and pressure vessels.

BS&B, with some of the largest and most modern custom fabrication facilities west of the Mississippi River, has become known as one of the industry's leading quality fabricators of custom equipment.

In our Oklahoma City plant, for instance, we are equipped to do automatic and semi-automatic submerged arc, automatic and semi-automatic inert-gas-shielded arc, manual arc and gas welding to conform to all recognized code requirements, and can fabricate plate thicknesses from 14 gauge through 4½".

Our well-equipped machine shops can fabricate both ferrous and non-ferrous alloys, solid and clad materials. In our 2300° F. annealing oven we can stress-relieve units measuring up to 80'-0" in length, 15'-8" in diameter and weighing up to 125 tons. The very latest in quality control, inspection and testing techniques and equipment are in constant use throughout.

Take advantage of BS&B's conveniently located modern facilities and years of fabricating experience on your next project! Our representatives will be glad to discuss it with you in strictest confidence. Or write to . . .

Contract Sales Division, Dept. 5-D7

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.

2131 Westwood Blvd. P. O. Box 1714 Oklahoma City, Oklahoma

As a reader of **PETROLEUM PROCESSING**

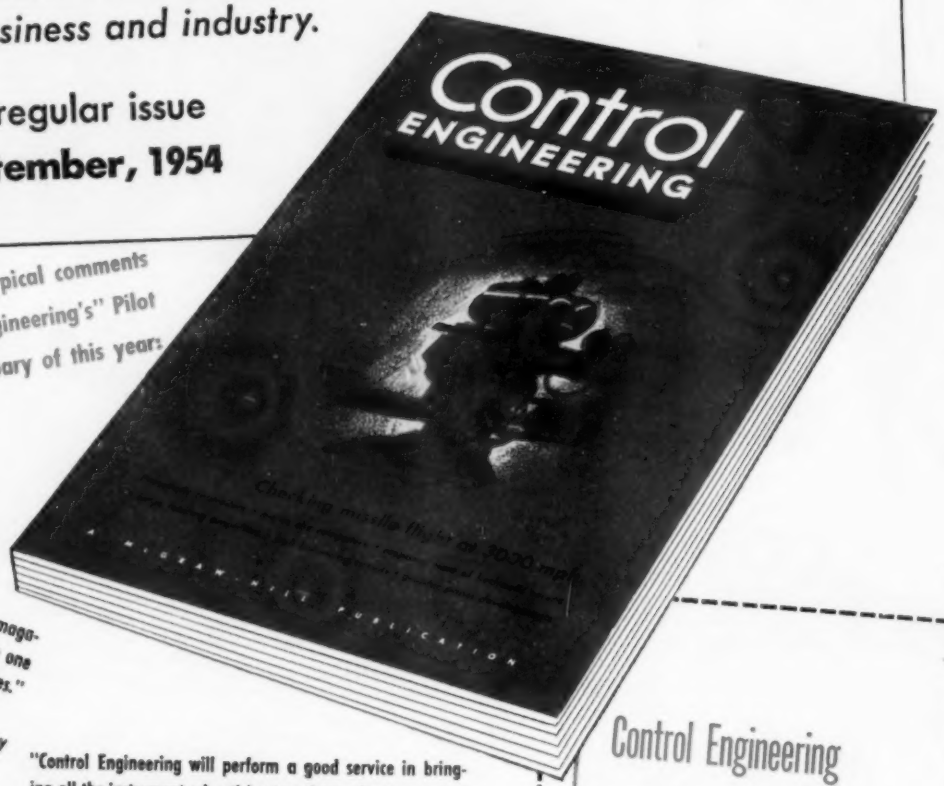
you are invited to become a charter subscriber to

Control ENGINEERING

INSTRUMENTATION AND AUTOMATIC CONTROL SYSTEMS

a new magazine devoted to the design and application of instrumentation and control systems in business and industry.

first regular issue
September, 1954



Here are some of the typical comments received on "Control Engineering's" Pilot Issue published in January of this year:

"You have produced an excellent magazine that should be well received in one of America's fastest growing industries."
Instruments Engineer
Textile Manufacturing Company

"Control Engineering will perform a good service in bringing all the instrument advertising together under one cover."
Engineer
Manufacturer of Chemical Machinery

"Control Engineering will be useful to those who make and use instrumentation."
Production Manager
Instrument Manufacturing Company

"Control Engineering fills a need and we would most certainly be a subscriber."
Director of Research
Paint Manufacturing Company

Control Engineering
330 West 42nd Street
New York 36, New York

(To obtain more data on advertised products see page 1112)

Conceived Over 10 Years Ago by McGraw-Hill Editors

Research in the science of feed-back systems during World War II brought a new dimension to the art of instrumentation and control for business and industrial processes and machinery.

Out of this development a new engineering art—the design and application of closed-loop control systems—has grown. It can provide a new level of productivity for American business and industry.

Since 1944, McGraw-Hill has been conducting a series of market analyses to determine editorial scope, circulation and advertising potentials for a magazine serving this field. The most recent of these studies, conducted early in 1953, indicated a strong current need for such a magazine among design engineers and technically trained management men in a broad range of industries.

Accordingly, in January, 1954, the first pilot issue of CONTROL ENGINEERING was published. Field surveys indicated an enthusiastic reception on the part of the men it was designed to serve. Many letters were also received praising its editorial scope and usefulness. Strong advertising support was voiced by leading manufacturers of instruments and control devices.

How CONTROL ENGINEERING Will Serve You

1, Every issue of CONTROL ENGINEERING will show you how instrumentation and automatic controls are being applied in your own and related industries. It will describe new methods as they are developed. It will describe them in terms you can use.

2. CONTROL ENGINEERING will serve as a shop and laboratory manual filled with down-to-earth, practical data. It will aid you as a management man interested in increased production, improved quality and lower costs. It will aid you as an engineer interested in the methods and equipment required to attain these goals.

An Editorial Staff of Recognized Ability Will Bring You Current Facts And Information On Instrumentation and Automatic Control

CONTROL ENGINEERING's Editorial Staff provides a unique pool of background expertness in all phases of modern control technology. At its command are the resources of McGraw-Hill's national and international business-news-gathering facilities and technical services.

System-Engineering

Associate Editor William E. Vannah, a specialist in the function of instrumentation in plant dynamics and contemporary instrument and system design, was associated for the past five years with the Research and Development Division of Foxboro Instrument Company.

Mathematician-Editor

George A. W. Boehm, formerly science editor of Newsweek, a mathematician and specialist in interpreting current technical developments, has been appointed Managing Editor of CONTROL ENGINEERING.

Servo-Technology

Associate Editor Byron K. Ledgerwood, formerly an editor of Product Engineering, specialized in reporting on servomechanisms in machine and system design.

Process Control

Business Editor Lloyd E. Slater, former Industry Manager at Minneapolis-Honeywell and Associate Editor of Food Engineering, specialized in development and application of automatic controls in processing.

Computer-Engineering

Assistant Editor Edward J. Kompass, formerly with The de Florez Company, Inc., is skilled in the design and development of digital computer technology.

Consulting Editors

Supplementing its working Staff, CONTROL ENGINEERING will draw upon the advice and experience of a Board of Consulting Editors comprised of four outstanding authorities in the field.

Subjects Like These Will Be Covered Regularly

—Analog Computers for Machine Control
—Automatic Gaging and Weighing Controls
—Automatic Selection and Transfer Methods
—Electrical, Electronic and Mechanical Controls
—Indexing and Recording Equipment
—Instrumentation Inspection Equipment
—Magnetic Tape Operating and Inspection Methods
—Punch Card Operating Equipment
—Servo Systems . . . and many more

Become A Charter Subscriber to Control Engineering Today

Charter subscriptions to CONTROL ENGINEERING are limited to top management, production management, engineering management and to control, design and processing engineers in manufacturing, processing and allied industries. These subscriptions are available *in advance of publication* at the low price of $3 for 1 year, $4 for 2 years, or $5 for 3 years. Simply fill out and mail the coupon and we will send you a memo bill *after* you receive your first issue of CONTROL ENGINEERING.

Please enter my Charter Subscription to *Control Engineering* starting with Vol. 1, No. 1 in September, 1954 at the low pre-publication price checked below. It is understood that I will be billed after I receive my first issue.

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Erkote 3X Insulating Mastic on these 40,000 barrel spheroids reduces evaporation losses

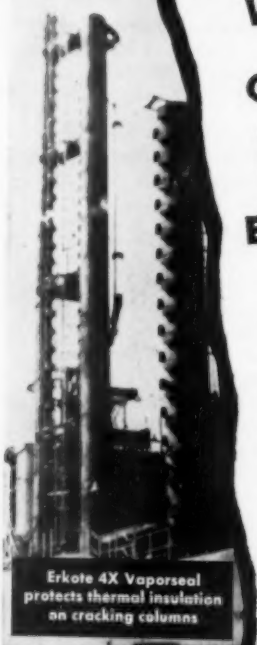
With protective coatings . . .

on-the-job performance is what really counts!

ERKOTE® Mastics have a record of proven dependability

In refineries, in paper mills, in chemical plants . . . in every type of industry where surface protection is a problem . . . ERKOTE Insulating and Corrosion Resisting Mastics provide a permanent protective coating. They are bonded to the surface in one seamless application that offers unusual resistance to chemicals, corrosive fumes and extreme weather conditions. Even under severe thermal changes, ERKOTE Mastics remain flexible . . . never dry out or peel off!

In addition, we produce our own mastics and paints and furnish our own trained crews to apply and maintain ERKOTE products. One source—one responsibility—for materials and workmanship!



Erkote 4X Vaporseal protects thermal insulation on cracking columns

Erkote 2X Corrosion Resisting Mastic protects this elevated water tower

ERKOTE TECHNICAL COATINGS

FOR USE WHERE PAINTS FAIL

see our catalog in Sweet's PLANT ENGINEERING FILE or write for copy

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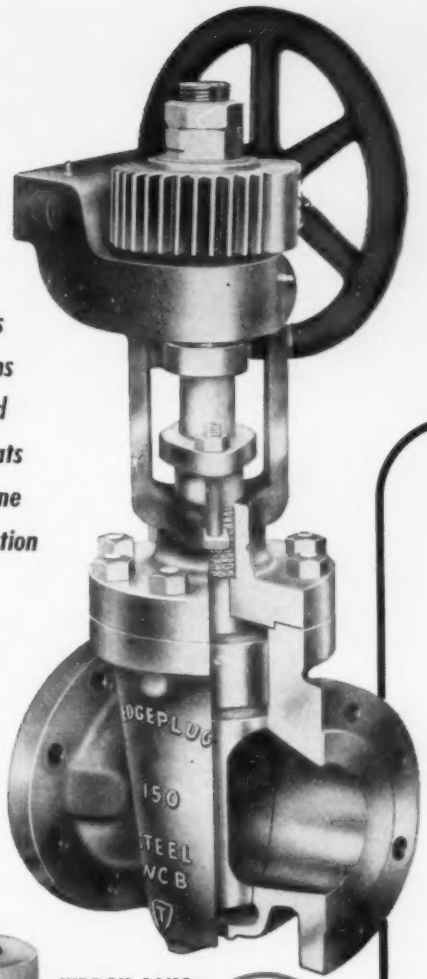
Erkote 2X insulates operating equipment — Erkote 2X rust-proofs steel supports

Erkote Mica Mastic waterproofs and beautifies these masonry buildings

for general service...

WEDGEPLUG
STEEL DRY PLUG VALVES

lifts turns and reseats in one operation



for special service...

WITH COATED PLUG

Wedgeplug Steel Valves, equipped with our Special-Coated Plug, are setting new standards for valve performance. The Special Coating, which is bonded to the metal, assures a tight seal, and is highly resistant to abrasion and corrosion. Ideal for handling Petroleum Oils, Liquefied Petroleum Gases, Gasoline, Kerosene, Air, Gas, Water, Vegetable Oils, Animal Fats, Alcohols, Turpentine, Acid Solutions, Alkaline Solutions, Saturated Salt Solutions, and many Solvents and Chemicals. . . . Recommended for operating temperatures between −40° and +200° F.

Available from Stock, with *Hycar-Coated Plug

MADE IN THREE TYPES: WRENCH-OPERATED HANDWHEEL-OPERATED • GEAR-OPERATED

*Hycar is the trade-name of the Product, made by B. F. Goodrich Chemical Co., used in coating Plug.

WEDGEPLUG VALVE COMPANY, INC.
NEW ORLEANS 15, LA.

An Affiliate of

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GENERAL OFFICES AND PLANT • BIRMINGHAM 2, ALA.

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Write for **WEDGEPLUG** *Catalog*

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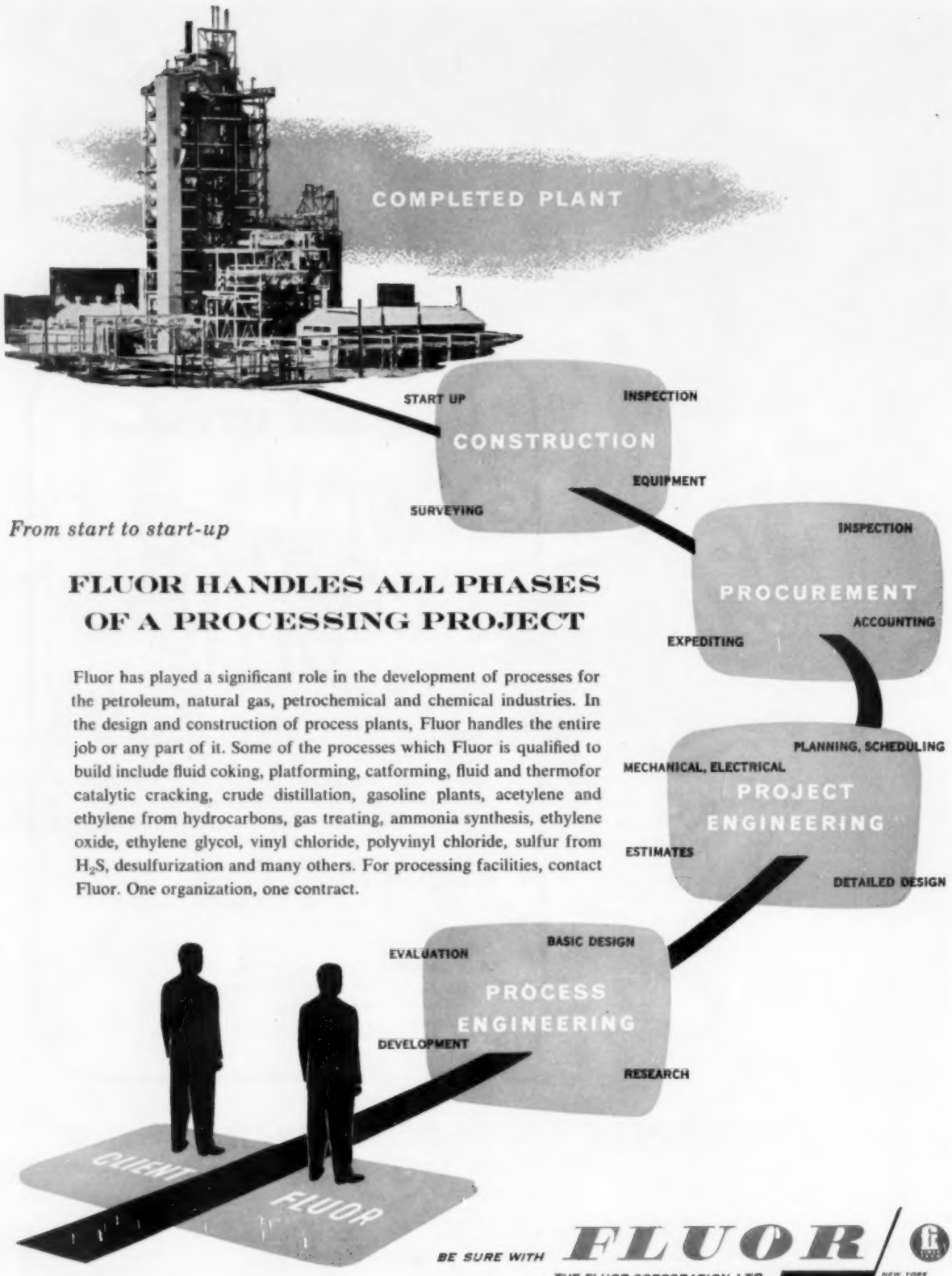

From start to start-up

FLUOR HANDLES ALL PHASES OF A PROCESSING PROJECT

Fluor has played a significant role in the development of processes for the petroleum, natural gas, petrochemical and chemical industries. In the design and construction of process plants, Fluor handles the entire job or any part of it. Some of the processes which Fluor is qualified to build include fluid coking, platforming, catforming, fluid and thermofor catalytic cracking, crude distillation, gasoline plants, acetylene and ethylene from hydrocarbons, gas treating, ammonia synthesis, ethylene oxide, ethylene glycol, vinyl chloride, polyvinyl chloride, sulfur from H_2S, desulfurization and many others. For processing facilities, contact Fluor. One organization, one contract.

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Illustration at bottom shows effect of high-velocity turbulently flowing sea water on the inlet end of an Admiralty tube. At the top you see the effect of high-velocity, turbulent flow of sea water around once-lodged pebble or shell in Admiralty tube cooled by sea water.

VELOCITY: how serious tube damage from this cause can be avoided

High velocity is a big factor in causing turbulent flow of the cooling water. This in turn may lead to rapid inlet-end corrosion of condenser tubes, particularly in plants on tide water. You can smooth out the flow of water by using deep water boxes and by flaring the inlet ends of tubes. And you should do away with water obstructions. All these help to increase tube life.

Where a tube is partially blocked by a pebble, shell or other debris, local high velocities can occur. It is highly desirable to prevent the entrance of such material into condenser tubes. But it's not always possible. If you want to avoid serious damage from this cause, inspect and clean tubes frequently.

Velocity is only one factor affecting tube life. Publication B-2, "Anaconda Tubes and Plates for Condensers and Heat Exchangers," discusses *all* the important operational factors, and gives much other useful information. And, of course, our Technical Department stands ready to assist you in the selection of tube alloys from our extensive line. *The American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.*

54196

ANACONDA®

Tubes and Plates for Condensers and Heat Exchangers

Arsenical Admiralty-439; Ambraloy-927; Cupro Nickel, 30%-702; and other copper alloys*

*U. S. Patent No. 2,093,685 (ORIG.)

(To obtain more data on advertised products see page 1112)

CLAD STEEL UNITS CHECK NAPHTHENIC ACID CORROSION

Corrosion is a constant threat in these naphthenic acid recovery units at a leading eastern refinery. Preheaters handle a mixture of the naphthenic acids, dissolved in a solvent of naphtha and isopropyl alcohol containing sulphuric acid, heating it to 350° F. After stripping, the naphthenic acid distillates—still corrosive—are cooled in a special acid cooler. Operation must be continuous, corrosion protection certain.

Economical stainless clad steel—in the tube sheets, floating head covers, channels and channel covers—stands up to this 24-hour-a-day operation and shrugs off corrosion. A layer of stainless steel—integrally and permanently bonded to a low-cost carbon-steel backing plate—gives all the benefits of the more expensive solid alloy. There is no danger of seepage or crevice corrosion . . . and the chance of equipment failure causing unscheduled shutdowns is greatly reduced.

But economical resistance to corrosion is not the only benefit clad steel equipment offers. The combined teamwork of sound engineering and modern fabricating techniques can take full advantage of the versatility of clad steels. You can look for tanks and pressure vessels that minimize first cost and assure long, trouble-free life . . . give maximum capacity in the least space . . . withstand high pressures and temperatures . . . resist thermal shock . . . permit easy and economical field erection.

You can profit by consulting your fabricators about clad steel's advantages *early* in your planning. Their close teamwork with your engineers and consultants will help give you equipment tailored to your exact processing needs.

Stainless-clad steel provides economical resistance to extreme corrosion in these acid stripping and cooling units.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 682 Lukens Building, Coatesville, Pennsylvania.

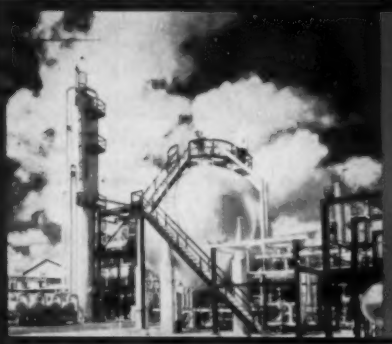
LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

INSURE REFINING EFFICIENCY with

PETRECO
ELECTRIC PROCESSING

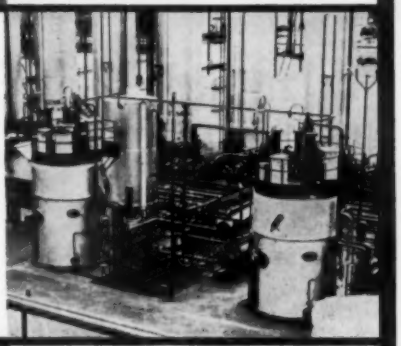


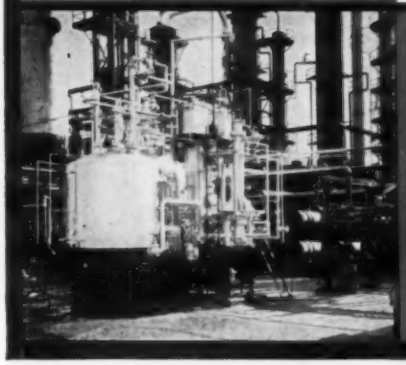
DESALTING

Recognized by leading refiners as the finest desalting process available because of high quality equipment and consistently higher salt removal percentages.

LUBE OIL TREATING

A continuous, automatically-controlled process, in a vapor-tight system, for acid treating lube oils and similar stocks.





DISTILLATE TREATING

Acid Contacting
Caustic Washing
Doctor Treating

Provides accurately controlled processing for the acid, alkali, or doctor treating of distillate stocks, continuously and automatically.

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A DIVISION OF PETROLITE CORPORATION

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OTHER PETRECO PROCESSES

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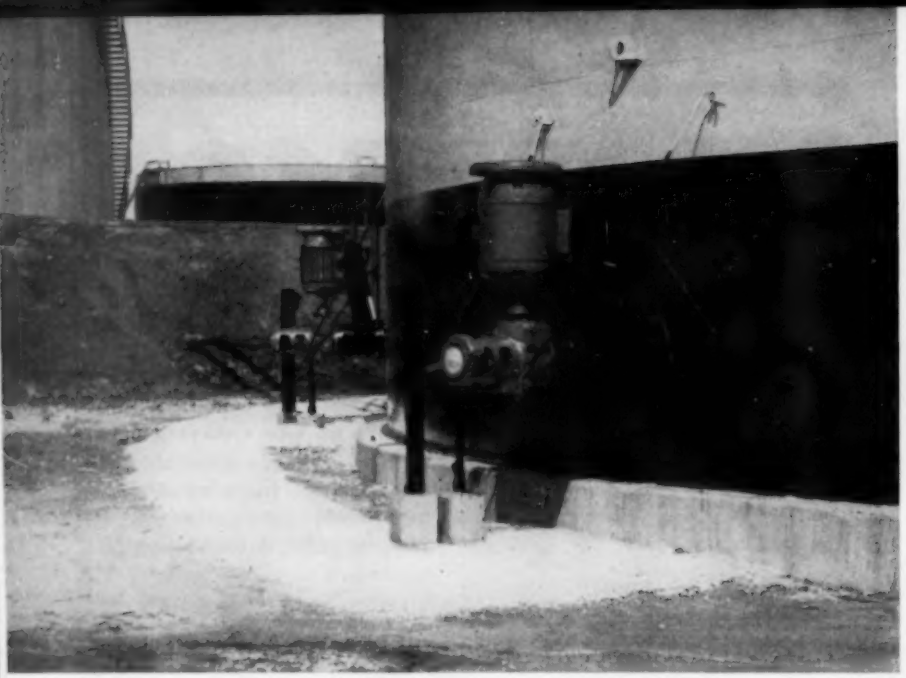
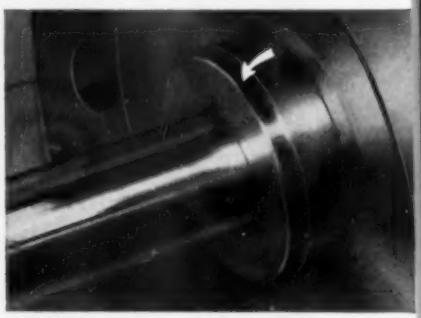
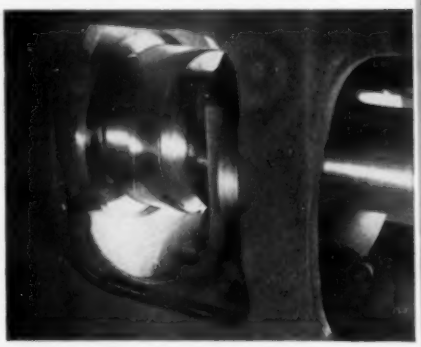
DE-HAZING • NITROGEN BASE REMOVING • ARSENIC REMOVING



1. **FASTER MAINTENANCE.** To repack (or change a mechanical seal), this shutoff assembly is turned like a valve, quickly sealing tank contents from mixer.



2. **SHAFT RETRACTS,** squeezing a Teflon gasket inside the tank between seal collar and mixer end cap, positively preventing loss of product.



3. **MECHANICAL SEAL** (optional) can be removed from shaft as a unit, for quick easy replacement. You can change seals without draining the tank and without dismantling the mixer.

NO SHUTDOWNS . . . *EVER* . . . to repack these mixers

Any fluid mixer on a big tank sooner or later requires some maintenance. A stuffing box needs repacking. A mechanical seal has to be replaced.

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EASY AS CLOSING A VALVE A few turns of the easy-to-get-at shutoff assembly prepare the mixer for repacking (or seal change). Every part is easily accessible.

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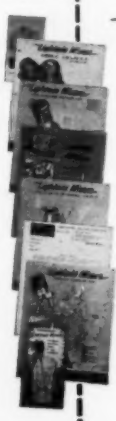

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PETROLEUM PROCESSING

JULY 1954

Push is on for 'Big Oil' Union

A Staff Report by the Editors of PETROLEUM PROCESSING

DEVELOPMENTS in the past few weeks have indicated that the proposed single, across-the-board, oil industry union could be an accomplished fact by late this year or early 1955.

- The Oil Workers International Union (CIO) in a special session in Cleveland June 2 voted to merge with other oil and chemical workers into the one new and bigger union—the Oil and Chemical Workers International Union.
- OWIU two days later in another session in Cleveland decided to seek a 5% wage increase for its members this year, although it promised it would not strike to get it.
- Central States Petroleum Union, largest independent union after the OWIU, began voting on the proposed merger when its Local 101 approved the proposed big union 571 to 375 on June 4 at Independence, Mo.
- Even wider, long-term aims beyond the single U. S. union were indicated earlier this year in Paris in April, when OWIU president O. A. Knight helped organize and became president of a new International Federation of Petroleum Workers.

The only apparent deterrents to the merger plan have been the lukewarm attitudes on part of non-OWIU unions. These groups have been relatively slow in making decision to support the OWIU-inspired, O. A. Knight-spearheaded, merger drive which first took definite shape last February in a meeting in Philadelphia of 31 different organizations—including OWIU, 26 independent unions, and four AFL groups.

However, first vote by CSPU local in favor of merger is seen by most observers as a good indication of probable trend.

The refining industry can therefore look eventually to a strong, national union with potential control of just about half of the nation's refining capacity.

The biggest boost to the merger plan came with the positive action of OWIU, when it voted 73,891 in favor of and 891 against the merger. OWIU, with a total membership of about 75,000, claims to represent about 130,000 (covering approximately 2,200,000 b/d of refining capacity).

In its decision to go after a 5% wage increase, OWIU put teeth into its merger action and took a definite step in showing other oil unions its intentions toward leadership. Such a raise would amount to about 11.25¢/hr., based on the current average wage of $2.25/hr.

Another big chunk of total U. S. oil workers will be on the merger bandwagon should CSPU continue the trend indicated by the vote of its local 101. CSPU represents some 30,000 employes of Standard Oil Co. (Indiana) — and about 384,000 b/d of refining capacity — through some 25 different locals. Local 101 is the employes of the Sugar Creek, Mo., refinery. Its president, Maynard Sands, is also president of CSPU, and has been involved from the early stages in the merger drive.

Although Sands got into a hassle with CSPU over the merger question some months ago, those differences have been ironed out and are seen as a strong indication of the way the wind is blowing. Sands resigned from CSPU presidency when CSPU backed down on merger support, but subsequently acceded to a request from the union to reconsider his resignation, and is today still head of this strong independent.

Knight's activities in forming and heading up new International Federation of Petroleum Workers are not immediately significant in terms of U. S. union. However it does provide merger campaigners with further evidence of Knight's strength as possible leader for the nation's oil industry employes.

AND ON THE FOLLOWING PAGES ▶

- **"Management Has to Change"—O. A. Knight**
- **OWIU Is Seeking a 5% Boost in Wages**
- **Big Union Future in Hands of Independents**

O. A. KNIGHT

'Management has to change'

THIS is O. A. Knight, president of OWIU and top proponent of "big union," talking (*in an exclusive interview with* PETROLEUM PROCESSING):

"Naturally, we believe that the planned merger of oil and chemical unions will mean a stronger union and will put more money into the pockets of the workers. This money will come from the cash register of the employers, of course.

"But, I honestly believe that this additional cost to the employers will be more than offset by reduction in the number of work stoppages, decrease in worker grievances, improved worker morale, and simplification of the personnel relations problem of the employers."

Knight also feels it will help the companies continue to get the cream of the crop of workers.

He admits that oil workers have gotten good pay in past years when compared with other industrial workers, and he says that is why oil companies have had the pick of the crop.

But, he contends that the margin between skilled oil workers' pay and pay by competitive industries has narrowed and that if it continues to do so, oil companies will no longer be able to get and keep the best employes.

Why is a merger needed?

"The oil industry," Knight says, "is partly organized, partly unorganized, and partly half-organized.

"Collective bargaining is split into thousands of contracts. Unorganized, partly-organized, and organized groups are playing against one another.

"The result is confusion, tension, ill-feeling, and waste motion."

Admittedly, this situation could be a disadvantage to a union, but how could it hurt the oil companies?

Knight replied: "Most major industries have quit wasting their time trying to destroy or weaken unions and are devoting their attention to the legitimate purpose of trying to hold down costs.

"They have streamlined bargaining and thus thrown off their shoulders thousands of petty personnel problems of a sort the oil company personnel men still continue to try to handle.

"The present situation in oil means trouble for the workers and their unions, high overhead costs for the stockholders, and a vast number of good salaries for professional industrial relations men who are engrossed in a million unnecessary details and too many overlapping and duplicating bargaining sessions."

Are labor-management problems any different now than they have been in the past year?

"The developments of recent vintage in oil industry unions and bargaining — developments which have industry management somewhat confused and baffled — actually present a challenge to oil management to enter into a new era which will be beneficial to them as well as to their employes.

"Now management has to change. Unless it can dream up some awfully clever gimmicks to replace the old paternalism and company unionism, it had better follow the lead of other industries and recognize that collective bargaining is here to stay. If they recognize this fact, they can concentrate on the economic issues with which their stockholders are deeply concerned."

Does he think the companies should yield to the unions on every point and, in effect, let the unions dictate the labor policies entirely?

"We don't expect management to hand us anything on a platter. We expect management to try to save money. But, we think management is deluding itself by continuing to cling to a 1925 viewpoint toward the employes.

"I'd like to say one more thing. Those industries which recognize strong national unions, concede they are here to stay and don't worry about breaking or weakening unions—those industries have less of what is sometimes called 'labor trouble,' less lost production due to strikes, than do half-organized industries such as oil."

How about strikes in the steel and auto industries, which have strong national unions?

"Sure, there is a lot of publicity when steelworkers strike or when General Motors is shut down by the auto workers; but over the years I dare say these companies lose less production than those industries which have a muddled bargaining situation—such as oil."

Aims Are World-Wide

Knight has set his sights much higher than control of the proposed new Oil and Chemical Workers International Union. One strongly probable target is the petrochemical workers and another is foreign processing plant employes.

By definition, the jurisdiction of the OCWIU will be: "the petroleum, gas, chemical, and allied or similar industries in the U.S. and Canada." Through the petrochemical plants in petroleum refineries, the new union would have an avenue to bring in workers in all chemical plants using raw materials extracted from petroleum or natural gas. By 1975, the CIO group has said, these materials may be supplying half the nation's chemicals.

Even farther afield than petrochemicals, it is reported that there have been conversations with top CIO officials on the possibility of bringing the Gas, Coke and Chemical Workers Union of the chemical industry into the proposed new union. The GCCWU has 80,000 members as against the present 130,000 oil industry employes claimed under control of the OWIU, which could make Knight a powerful figure in a combined organization.

Knight also took active part and became president of the newly organized International Federation of Petroleum

Workers in Paris last April. Delegates from 13 nations—not including Great Britain—participated in the convention which established this world-wide labor organization. Besides Knight as president, the Federation elected Lloyd Haskins, OWIU-CIO international representative, as general secretary. Permanent headquarters are in Denver, were Knight maintains his own offices.

The constitution of the Federation provides it shall include, "the free trade unions of all countries, irrespective of the color, nationality, race, or creed of their members, engaged in the production, pipeline transportation, refining, petrochemical operations (Within the limits defined jointly by an agreement between the International Federation of Industrial Organizations, the General Workers Union, and the International Federation of Petroleum Workers), and marketing of petroleum and natural gas, and related operations of allied groups."

The clause in the parentheses refers to a dispute with existing labor unions in Europe over the jurisdiction of the Federation over European petrochemical workers. It was decided the Federation would be limited to unions engaged in refining and petrochemical operations, excluding unions in companies not directly associated with the petroleum industry.

The new Federation plans a meeting this coming fall, when attempts will be made to affiliate with British, Mexican, Iranian, and Iraqui unions.

Big Union Future in Hands of Independents

THE next step in the campaign for an all-inclusive, single union for the nation's oil industry is to secure approval to merge from all labor organizations in addition to the Oil Workers International Union.

This includes the 26 independent and 4 American Federation of Labor unions who sent delegates to the "merger" convention in Philadelphia last February, as well as any unions not present. A tentative constitution was drawn up at that time.

Other unions are not to be hurried into taking action on the proposed merger, stated O. A. Knight, OWIU president and powerful supporter on the big union idea. He said in Cleveland at June meeting that he hoped approvals for merger would be forthcoming in the next few months so that the formal ratification of the constitution could take place before the end of the year.

A tentative date of August 23 had been set at Philadelphia for the ratification convention. However, it seems certain now that not enough unions will have acted by that time to make a convention feasible. No new target date has been set.

It will not be necessary for all groups represented at the Philadelphia meeting to pass on the merger proposal before the ratification meeting is called. Knight is chairman of an interim CIO committee which will decide the date for the ratification meeting. An OWIU legislative committee is studying changes in its own constitution which will have to be made to conform to the constitution of the new union.

A point under discussion, especially since the OWIU vote favoring the merger, is whether the new organization will affiliate with the CIO national organization. Knight and other CIO leaders have avoided a direct position here by stating the new union could not take such action until it is fully organized as an entity itself.

It is considered good strategy to avoid affiliation talk for its possible effect on some of the independent or the AFL groups. Authorities are convinced that at the proper time, the new union will affiliate with the CIO and Knight will be elected its president. Knight has said that, although he favors CIO affiliation, he is willing to let the members of the new union vote on the matter.

Chief purpose of the proposed Oil and Chemical Workers International Union is to increase the unions' bargaining strength in wage and other matters affecting workers. The OWIU, at its Cleveland meetings, drafted a 16-point "selling" campaign to convince OWIU members, and members of other unions, of the desirability of the OCWIU.

The added strength gained through the merger will come from the present independent unions throwing in with the new deal. A strike of refinery workers called by OWIU in the summer of 1952, without very great support from other unions, tied up 56 refineries and reduced U.S. crude runs by about one third for almost a month. Potential coverage of the proposed merged union would come to an estimated half of the nation's refining capacity.

Apathetic attitude on part of independents, which OWIU anticipates overcoming, has been attributed mainly to the fear they would have to give up the close contacts they now enjoy with management as independents. This was seen, for example, as the story behind the hassle a few months ago in the Central States Petroleum Union, when its president Maynard Sands—a merger proponent—resigned because of apparent CSPU apathy and then later returned to the presidency.

Another example of non-support has been on the East Coast. A world-wide union of employes of Standard Oil Co. (N.J.) and its affiliates is the immediate goal of a Coalition Committee of Petroleum Unions (Esso Standard employes). This committee was scheduled to meet a few weeks ago to draft a constitution and by-laws for an "international type" Jersey Standard union.

J. Henry Benhoff, chairman of the coalition group, stated that, if this did not prove acceptable to the Jersey Standard workers, the idea would be pushed of participating in the proposed merger with the OCWIU.

Resistance was also reported in the Independent Oil Workers Union of Oklahoma, made up of Continental Oil Co. employes. Doyess Boyett, vice president, was a delegate to the Philadelphia meeting last February and was on the Temporary Ratifying Committee for the proposed new union.

No official expression has yet come as to the scope of the bargaining contemplated for the proposed union. However, the constitution which has been developed gives full power to conduct bargaining on a broad scale to a bargaining policy committee. The committee is made up of the officers of the union, members of the International Executive Board, district directors, and one rank-and-file member elected by the district council of each district. A statement issued at OWIU headquarters set forth the "bargaining intentions" of the new union as interpreted by the Temporary Ratifying Committee, of which Knight is chairman, as follows:

"1—We believe that collective bargaining on the part of the unions should be on the same level that com-

pany policy decisions are made. Those items of company policy which are fixed at the plant level should be negotiated at the plant level. Those items which are fixed at the top headquarters of the company should be negotiated with company management on a company-wide basis.

"2—All negotiations by the union should be carried on by elected committees of employes, whether this be at the plant level or the company-wide level.

"3—We do not believe that an industry-wide contract would be proper or feasible at this time or in the foreseeable future. At least insofar as substantial-sized companies are concerned, we do not believe that any two companies should be covered by the same contract.

"4—We believe it ridiculous to negotiate dozens of separate plant-by-plant agreements with a single company pertaining to those items—such as pension plans, savings plans, basic wages, etc.—which obviously must be uniform throughout the company and which must be determined, on the company side, by top management.

"5—We believe that while in ordinary circumstances the employes of different companies should be under different contracts, the employes of the various companies should cooperate with one another through a single international union for oil and related industries, just as the various companies cooperate with one another through the American Petroleum Institute, the National Petroleum Council, and various other organizations, and through jointly-owned subsidiaries (particularly pipelines), products exchange agreements, etc."

In summary the statement says the new union seeks precisely the same degree of industry-wide, company-wide and inter-company cooperation on the part of employes as is now exercised by management. "We seek no so-called 'monopoly' greater than that now practiced by industry. Whenever the industry sees fit to split itself into hundreds of separate, unconnected and uncoordinated plants, we will be willing to revert to the status of hundreds of separate, unconnected and uncoordinated local unions. We hope simply to follow the pattern of national coordination set by our employers."

Support is to be "sold" to the independent unions by OWIU under the following 16-point program, which was drafted at its Cleveland meeting in June. These are benefits OWIU says should result from the merger:

1—Better living standards.

2—Greater bargaining strength.

3—Avoidance of duplicate organizational efforts.

4—Expanded and more effective research and educational facilities.

5—More effective voice in legislation for the benefit of the workers.

6—Wider participation in local, state, national, and foreign affairs.

7—More and better over-all services for much less money to the individual members.

8—Concentrated bargaining programs.

9—More and better trained staff experts for negotiations and grievances.

10—Enlarged publicity facilities.

11—Development of community housing, welfare, health, and recreational programs.

12—Extension of legal services.

13—Establishment of a department of specialists to handle pensions and benefit negotiations with employers.

14—Many other worker benefits.

15—Fewer strikes in the industry.

16—Implementation of safety programs.

Non-union employes and management alike will give this program a careful look, seeking out items which already are actual facts—even in companies with no union program. They will be looking for "campaign promises," and quite probably be like the man from Missouri who "has to be shown" before he will believe anything at all.

OWIU Asks 5% Wage Boost

MEETING in Cleveland at the same time the merger into one all-inclusive union was approved, the OWIU Policy Committee decided the union should immediately seek for its members a general wage increase of 5%, or its equivalent. This would amount to about 11.25¢/hr. for the average oil company worker's wage of $2.25/hr. CIO bargaining units may adjust upward the amount asked where it is believed justified.

Chief reason cited for seeking a wage increase for refinery workers is their increasing productivity, due to the introduction of automatic controls and other modern devices in the plants, "which require an ever higher level of skill on the part of workers".

Each bargaining unit of the OWIU is asked to proceed to negotiate for the specified wage increase as quickly as possible under terms of their present contracts.

The strike of refinery workers back in June of 1952, directed by the CIO union with the support of a few AFL and independent unions, asked a 25-cent wage increase but settlement was for 15 cents granted by the government's Wage Stabilization Board.

In a surprise and entirely unprecedented move, the CIO union promised that it would not strike, threaten to strike or even take a strike vote during the coming wage negotiations. This pledge however, will not apply to controversies other than wages.

A union spokesman, explaining this action, said the members were tired of hearing complaints that labor negotiators always came to the conference table with "loaded pistols," meaning a strike vote or strike threat.

The statement issued by the OWIU Policy Committee finds an increase in wages is justified by:

"1—The increasing productivity of oil workers. While the number of workers employed by the petroleum industry is steadily declining, the volume of production and sales and the net profits of the oil companies continue to increase. Fewer men are achieving greater production and higher profits for the companies and should share in the fruits of this accomplishment.

"2—The increasing productivity of the economy in general. Throughout our economy, production is increasing —or is capable of increasing—at a much faster rate than consumption. Increased wages are needed to stimulate purchasing power and thereby provide a market for the increasing flow of consumer goods.

"3—Insufficient compensation for the skills of oil workers. The application of elaborate new equipment, electronic controls and other automatic devices in the oil industry requires an ever higher level of skill on the part of oil workers. Oil workers' wages, while high in relation to those in some other mass production industries, are in many cases low in relation to the skills required."

WORK-LOAD ANALYSIS GIVES YOU THIS INFORMATION	WHICH YOU USE TO IMPROVE SHOP PERFORMANCE ON THESE JOBS		
	FOR RE-LAYOUT OF SHOPS AND TOOLS	FOR FORWARD PLANNING OF MAINTENANCE WORK-LOAD	FOR DAILY SCHEDULING OF MAINTENANCE WORK-LOAD
Percentage of time spent on each class of refinery equipment repaired (by craft)	To determine the best relative location of craft shops	To determine classes of equipment of most importance to shop and to each craft	
Machine tool work-load for each class of refinery equipment repaired (by craft and machine tool)	To determine what machine tools are needed: to determine the best relative location of machine tools	To determine how much shop capacity should be allotted for each class of refinery equipment	
Hand work-load for each class of refinery equipment repaired (by craft)	To determine how much assembly area is needed and where this space should be located in each shop	Same as above	
Amount of advance notice given for shop repair work.		To determine the degree to which peaks and valleys in shop load could be eliminated	
Work content of shop jobs		To determine best way of estimating the time needed for new work coming into the shop	To determine the work content of each job arriving at the shop
Average elapsed repair time for each class of refinery equipment repaired			To determine the average daily work load of each job arriving at the shop

WORK-LOAD ANALYSIS

A Key to Better Shop Maintenance

By SIMON H. WAREHAM, Jr.
McKinsey & Company

TO streamline the flow or repairs through the shops and to strengthen shop planning and scheduling procedures at its Bayway, N. J., refinery, Esso Standard Oil Co. has turned to—and used—the facts obtainable through work load analysis.

In the chart above, in the first column at the left (under the first big arrow) is shown the information Esso needed—and got by work load analysis. In the next three columns (under the other arrows) is shown why the information was needed—the kinds of jobs on which performance could be improved.

With maintenance as with manufacturing, Esso found that a better knowledge of the work load—the extent of the jobs being done—permits a better utilization of men, machines, and facilities.

Maintenance is big business at Bayway. And it is treated as such. All future work is programmed, and the completion of day-to-day work is controlled by scheduling. It is big business because about 1900 people are needed to do the job. Of these, 300 people—representing 12 separate crafts—are in the maintenance shops. And they use 150,000 sq. ft. of floor space to carry out their activities, which range from making special nuts and bolts to repairing 10-ton heat exchangers.

Of all the problems in the management of such a sprawling giant, the improvement of speed of work completion in the shop was one of the most pressing. The solution to this problem involved two things:

1—A relayout of machine tools and individual craft shops to reduce materials handling and to relieve congested areas.

2—Better control of shop work through longer range planning and improved scheduling of completion dates.

But, remedial action could not be taken on these generalities. First,

WORK-LOAD ANALYSIS SOLVES THESE TYPICAL PROBLEMS

BY SUPPLYING YOU WITH THIS KIND OF INFORMATION

1—LOCATION OF CRAFT SHOPS

Class of Equipment	% of Total Shop Time	% of Craft Time: Machinist	Boiler-maker	Welder	Pipe-fitter
Exchangers	19	9	25	7	...
Fabricated pipe	12	5	..	50	100
Pumps	11	50	..	..	...

2—MACHINE TOOL REQUIREMENTS

Class of Equipment	Machine Hours per Month: Lathe	Radial Drill	Horizontal Boring Mill	Vertical Boring Mill
Pumps	1500	40	...	200
Exchangers	...	200	200	200
Valves	30	20	60	50

3—SHOP LAYOUT

NOTE: Use analyses in Examples 1 & 2 above.

4—ADVANCE PLANNING

Craft	% of Total Craft Time: Construction Work	Major Overhauls	Regular Maintenance
Machinists	13	3	84
Welders	16	35	49
Boilermakers	16	16	68
Pipefitters	14	40	46

5—WORK CONTENT

NOTE: Analysis is outlined in text.

6—PLANNING IN-PROCESS TIME

Class of Equipment	Size Range	Elapsed In-Process Time
Motors	1 - 5 hp.	3 days
	5 - 10 hp.	5 days
	10 - 20 hp.	8 days
Centrifugal pumps	1 - 2 in. nozzle	4 days
	2 - 4 in. nozzle	6 days

specific plans were needed to show:

1—Where each craft shop should be located.

2—How many and what kind of machine tools were needed.

3—How machine tools and assembly areas should be arranged in each shop.

4—What kind of planning and scheduling procedures would be most effective.

Understanding the work load was the one common denominator in the development of these plans. And the best single approach—the key—then became a work load analysis. How it was used is discussed below and shown in the chart on this page.

1—Location of Craft Shops

Three factors were important in determining where each of the craft shops should be located in the maintenance shop building:

1—Need for accessibility to the outside for handling bulky items.

2—Need for locating adjacent to other craft shops to reduce materials handling.

3—Physical limitations of the existing maintenance shop building.

Naturally, the final locations for each shop represented a compromise based on the relative importance of each of the factors to each craft.

But how was the compromise developed? Work-load analysis provided the facts upon which a sound decision could be based.

All refinery equipment repaired or fabricated from raw materials in the maintenance shops was divided into equipment *classes;* e.g., heat exchangers, pipe, pumps, motors, instruments, etc. Each class of equipment was then analyzed to determine the percentage of time spent by each craft and the shop as a whole on that class of equipment.

The analysis shown for Example 1 in the chart provided the factual basis for determining the location of each craft shop. For example, it shows that of three classes of equipment (which are only illustrative), exchanger repair facilities should be given first priority in assigning space, fabricated pipe facilities second priority, and pump facilities third. In addition it shows which shops should be located close together to minimize the movement of materials between the various craft shops.

Through this process of determining the relative importance of each class of work, a shop layout was developed that minimized materials handling among the twelve separate craft work areas at Bayway.

2—Machine Tool Requirements

Determining the machine tool requirements in a maintenance shop presents the same kinds of problems as in any job shop. Flexibility is the rule and work-loads on machine tools cannot be measured precisely.

But, again, work-load analysis provided the facts needed. Example 2 in the chart shows how this was done in Esso's machine shop.

It shows how work load by craft and class of equipment, as in Example 1, can be further broken down. The total work load for each type of machine tool was determined by completing the analysis for each class of equipment repaired in the machine shop. The machine tool work load in the boilermaker and pipefitter shops was determined in the same manner.

3—Layout of Shops

After determining the location of individual shops and the number of machine tools required, the question to be resolved was: "How should machine tools and work areas be arranged in each shop to minimize movement of materials?"

Here, too, work-load analysis provided the facts needed to develop sound decisions.

The final arrangement in each shop was based on the relative importance

of each class of work to the craft concerned. For example, work-load analysis had shown that 50% of the machinists' craft time was spent on pumps (see chart and Example 1).

In addition, work-load analysis had shown that 40% of the pump work was machine tool work and the balance, 60%, assembly and disassembly (hand work). Finally, work-load analysis had shown that 86% of the machine time for pumps was spent on lathes (see chart and Example 2). These factors indicated that:

1—Pump repair facilities should be the dominant consideration in layout of the machine shop, and

2—Lathes should be located as close to the assembly-disassembly area as possible.

Thus, work-load analysis provided the facts for developing an efficient layout based on the relative importance of the equipment repaired in each craft shop, and the machine tools and craft hand labor required for this work.

4—Planning and Scheduling

With the shop layout streamlined to minimize materials handling and to relieve congested work areas, the remaining problem was to strengthen planning and scheduling procedures. The facts developed in work-load analysis again provided the basis for solving this problem. Answers were needed for these questions:

1—What portion of the work could be planned in advance?

2—What was the best way of determining the work content of shop repair work?

3—What was the average time needed to complete the various repair jobs in the shop?

These questions were answered by further study of the points developed in analyzing the work load.

Advance Planning: All shop work was classified into one of these groups: construction work (capital improvement projects), major overhauls (turnarounds), and regular maintenance. The timing of construction work can be planned far in advance and major overhauls can be scheduled for about a year ahead. Thus two elements of the work load lend themselves readily to advance planning.

The analysis of these three classes of work is shown in the chart for Example 4. It shows that the uneven work load due to major overhauls can be eliminated or minimized by proper planning of construction work.

For example, in the boilermaker's craft 16% of the time is spent on construction work and 16% on major overhauls. Thus, by scheduling construction work in periods when no major overhaul is in process, a fairly uniform work load should result.

A further analysis of regular maintenance revealed how much capacity should be set aside to handle emergency repairs.

Work Content: Methods that could be used to determine the work content (man-hours of repair time) of jobs arriving at the maintenance shop were: 1) estimating from engineering drawings and sketches, 2) estimating on the basis of historical records, and 3) estimating by visual inspection of each job.

Analysis of the work load by these classifications showed that about 25% of the total shop load could be estimated from engineering drawings or shop sketches. Fabricated pipe is an example of work of this class.

Another 48% might be estimated from past experience as indicated on shop records. Averages thus developed could be used to determine the approximate labor requirements for repairing various sized pumps, motors, exchangers, and instruments. However, the necessary historical information was not available in suitable detail for all these classes of work. In these cases it was decided initially to estimate each job by visual inspection.

The other 27% of the work load could not be estimated except by visual inspection of each job.

In-process time: This covers the total time the work is in the shop. It includes the time needed to order and receive the needed materials, fabricate replacement parts, and complete other alterations that may be required.

For the present, the elapsed time between receipt of repair work in the shop and the completion date requested by the operating unit needing the work is the in-process time. In the long run it is planned to develop estimates of the average elapsed in-process time for each size and kind of refinery equipment. This is shown in the chart for Example 6.

The objective of scheduling was to ensure that jobs were completed when needed while at the same time permitting maximum flexibility to foremen in determining the sequence of jobs, within the framework of the scheduled completion dates. To achieve this objective it was important to do two things:

1—Establish realistic completion dates.

2—Control the amount of work released to the shops.

These requirements were satisfied by developing work schedules that considered:

1—The work content (man-hours of repair time) of the job.

2—The in-process time to complete the repair.

Work content divided by the in-process time showed the average daily work load of each job. Comparison of shop capacity to the total projected average daily work load (sum of the daily work load for each job) showed when a new job could be started and completed.

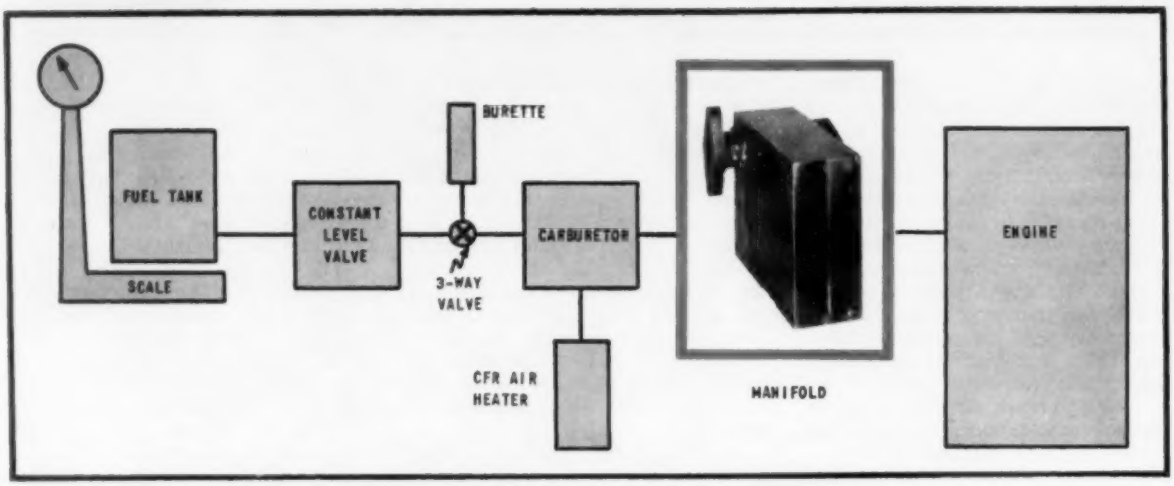
Esso management recognizes the important effect good maintenance can have in achieving high productivity from its process equipment. And for the 1,900 maintenance people operating in all four corners of the 1,600-acre Bayway refinery to use their time effectively, the maintenance shops must complete their work on schedule.

Meet the Author

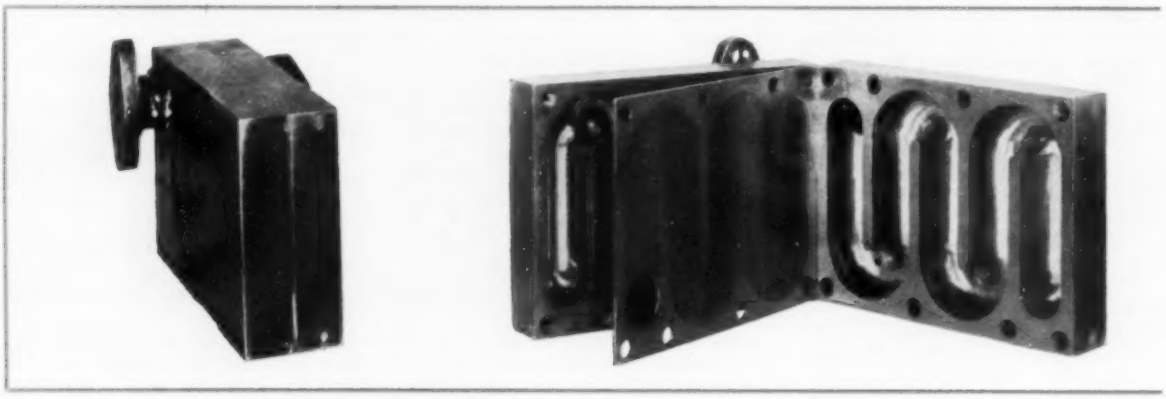
Simon H. Wareham, Jr., has been with McKinsey & Company, New York City, management consultants, since 1949. He was with the Eastman Kodak Co. in Rochester from 1941 to 1949, except for four years with the Navy during World War II.

At McKinsey & Company, Mr. Wareham is a consultant in the field of manufacturing. He has worked closely with some of the country's leading corporations (including petroleum) on their problems in the areas of maintenance, facilities planning, production control, and organization.

Mr. Wareham is a graduate engineer from Iowa State College and received his Master's degree in Business Administration from the University of Rochester.



SPECIAL ENGINE TEST for gasoline stability, showing location of manifold



SPECIAL MANIFOLD ITSELF, used in collecting data on stability factors

New Test Unit Shows Gum Not Only

GUM build-up alone can no longer be used as the sole criterion of gasoline engine induction system deposit-forming characteristics.

A test program using an especially-designed manifold apparatus has indicated that other fuel factors are also of importance; for example, antioxidant type peroxides formed by incomplete inhibitor sweetening, and trace phenol constituents. Data from tests run by Socony-Vacuum Laboratories on the apparatus developed at Paulsboro, N. J., show all these factors can contribute to instability under conditions of use in a manner not predicted by ASTM gum or other current accelerated test procedures.

Many laboratories have realized the inadequacy of such accelerated stability test procedures for predicting

By A. V. CABAL
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ASTM gum build-up under conditions of *storage*. Further, the ASTM gum has also been used in the measure of preformed gum under conditions of *use* in an automotive engine.

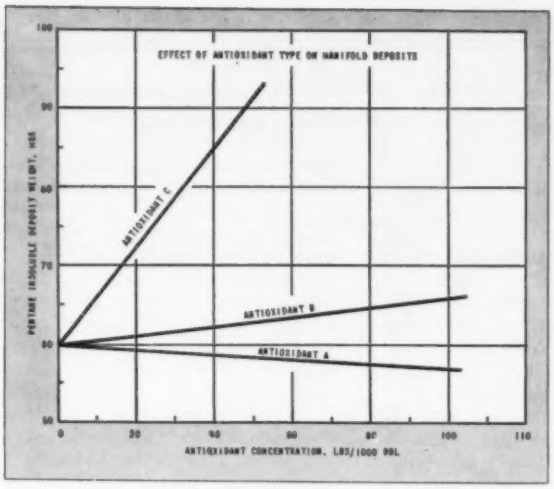
However, for the past three years it has been recognized that: either present day automotive equipment is more sensitive to ASTM gum content of the fuel, or factors other than ASTM gum contribute to induction system deposits.

This article will be concerned with studies of the latter, which has led to another concept of stability; namely, "stability under conditions of use," i.e., the tendency for gum formation to take place within the carburetor and intake manifold of the engine.

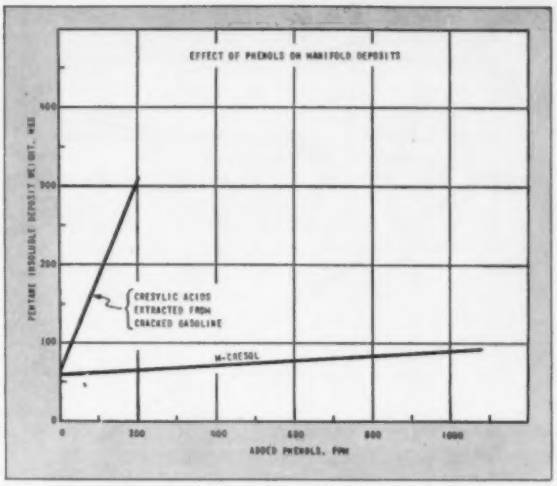
The manifold test unit, similar to techniques employed by several other laboratories, consists of a specially-designed manifold attached to a single-cylinder, air-cooled, Wisconsin Motors engine, with provisions for control of fuel rate and temperatures.

As illustrated above, an accurate measure of hourly fuel consumption is obtained by providing a platform scale for the 5-gal. fuel tank. However, fuel rate may be determined at any time by means of a burette attached to the fuel line through a three-way valve. A constant fuel head is maintained through a liquid level control valve which facilitates uniform fuel rate.

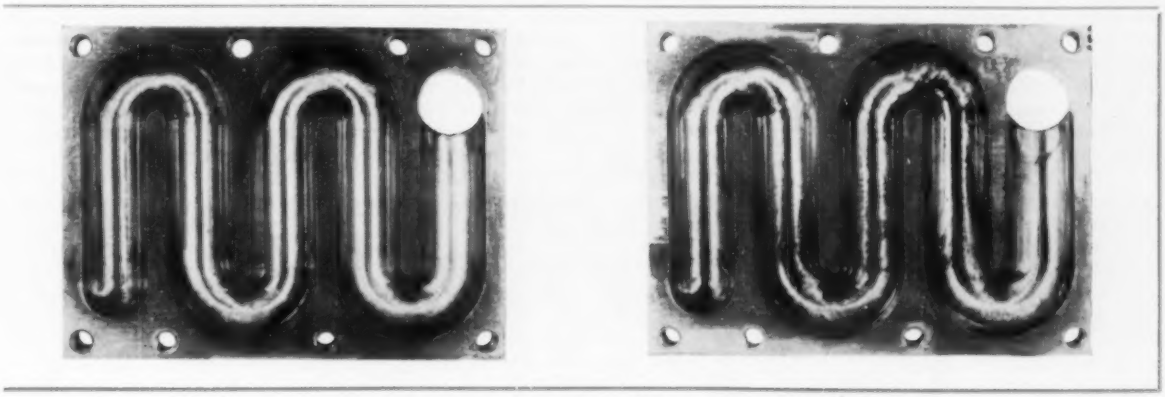
Carburetor inlet air temperature is



THE TYPE OF ANTIOXIDANT, as well as . . .


EFFECT OF PHENOLS ON MANIFOLD DEPOSITS
PENTANE INSOLUBLE DEPOSIT WEIGHT, MGS
CRESYLIC ACIDS EXTRACTED FROM CRACKED GASOLINE
M-CRESOL
ADDED PHENOLS, PPM

PHENOLS are among factors affecting fuels



HOW DEPOSITS LOOK in the special test manifold when caused by antioxidants

Factor Affecting Gasoline Stability

controlled by a CFR air heater ahead of the conventional carburetor. The effluent air-fuel mixture from the carburetor enters the manifold which is heated by two 500-watt, pancake electric heaters attached to the manifold exterior.

The manifold design permits opening for inspection and quantitative measurement of deposits as illustrated by the photographs. Overall manifold exterior dimensions are only 4½ x 5⅞ x 2 1/16 in., but a manifold passage approximately 36 in. in length is provided with a cross section area of 0.63 sq. in.

The somewhat unusual length of 36 in. was chosen only after previous work with an 18-in. length had shown that it was not possible to insure that all deposits would form in the manifold rather than in the carburetor or on the inlet valve when evaluating fuels of widely varying volatility characteristics.

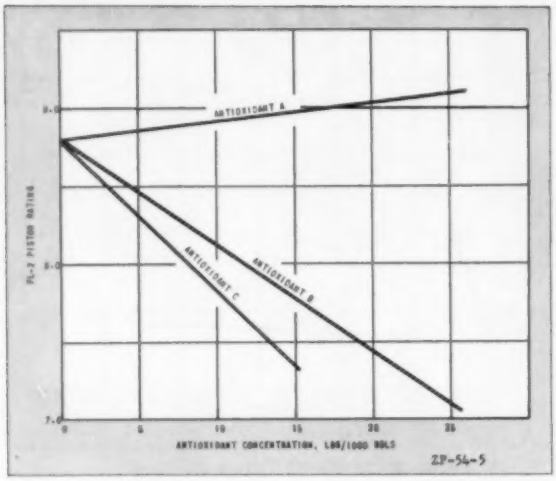
Test procedure requires 4 gals. of fuel, which are consumed in 13½ hrs. engine operating time. The carburetor air is preheated to 150°F and 13:1 air-fuel ratio is maintained. The manifold temperature averages 255°F and is regulated by the two external electric heaters to maintain a 240°F air-fuel mixture temperature at the manifold outlet.

Quantitative measurement of deposit weight is obtained by: 1) washing the manifold interior with pentanes to remove the oily residue, if present; and 2) dissolving the pentane insoluble residue with a mixture of acetone, methanol and benzol. The solvents from both washings are evaporated and the residues weighed individually. However, the weight of the pentane insoluble deposits is considered the more significant.

Experimental Work: The following discussion is intended to illustrate trends with regard to induction system deposit forming tendencies measured by the manifold test. No effort will be made to express these trends in terms of engine mileages. Since ASTM gum is a contributing factor to induction system deposits; gum content, in so far as possible, was maintained constant.

Effect of Antioxidants

The relative effect of three commercial gasoline antioxidants upon



PISTON RATINGS (FL-2) ALSO are affected by antioxidant type

Table 1—Effect of Peroxides Formed by Antioxidant Sweetening

		Properties of Aged Blend			
Antioxidant	Initial Mercaptan Sulfur, Wt.-%	Mercaptan Sulfur, Wt.-%	Peroxide No.	ASTM Gum, Mgs./100 ml.	Pentane Insolube Manifold Deposits, Mgs.
A	0.009	0.009	NIL	0.9	171
B	0.009	0.003	0.6	1.4	828
C	0.009	0.009	NIL	0.7	276
A	0.003	0.003	NIL	NIL	131
B	0.003	0.002	0.3	1.2	465
C	0.003	0.003	0.1	0.1	148

the manifold deposits is illustrated in the graph. In these tests the additive concentrations were extended to abnormally high levels to confirm the small differences observed at lower concentrations. The additives were tested in a blend containing 60%-vol. catalytic cracked and 40%-vol. thermal cracked gasolines. The ASTM Induction Period of the uninhibited blend was 365 minutes.

As indicated in the graph, antioxidant *A* did not contribute to manifold deposits. In fact, antioxidant *A* had a tendency to reduce deposits while antioxidants *B* and *C* increased manifold deposits, with antioxidant *C* forming by far the heavier deposits. Inasmuch as antioxidants *B* and *C* increased the pentane insoluble deposits it would appear that a portion of these antioxidants had been oxidized to an undesirable form because both antioxidants were pentane soluble in their original state.

A visual comparison of the manifold with 100 lbs./1000 bbl. of antioxidants *A* and *B* is presented in the photographs on page 1045. The latter illustrates the sensitivity of this test, in terms of appearance, to small deposit weight differences.

Data have also been obtained which show that factors which contribute to induction system deposits may affect power section cleanliness. These data, which are presented graphically, show the result of FL-2 piston ratings as affected by the three antioxidant types tested.

The FL-2 test is a low temperature-high load laboratory engine procedure for measuring power section deposits wherein pistons are rated on a scale of 10 for a perfectly clean piston and zero for a dirty piston. Here, as in the manifold test, antioxidant *A* indicated a slight improvement over the base fuel while antioxidants *B* and *C* resulted in a dirtier piston rating.

The same relative order has been observed in passenger car field tests although the spread in ratings among the three additives was considerably less than in the case of the FL-2 test.

Effect of Peroxides and Antioxidant Sweetening

Antioxidant sweetening is a process employed to reduce the mercaptan sulfur content of a gasoline by oxidation to the disulfide form. As is the case with most commercial processes, antioxidant sweetening is subject to limitations. While no attempt will be made to discuss the latter, it is significant that the formation of peroxides and increased deposits have been observed with some antioxidant sweetened stocks and is a potential phenomenon which can be encountered under some conditions.

The effect of aging a thermal cracked-straight run motor gasoline blend containing 0.009 wt.-% mercaptan sulfur with each of three antioxidant types is presented in Table 1. The mercaptan sulfur content of blends containing antioxidants *A* and *C* did not change. No peroxides were formed and manifold deposits were 171 mgs. and 276 mgs., respectively. The mercaptan sulfur content of the blend containing antioxidant *B* de-

Meet the Author

A. V. Cabal, author of this article on motor gasoline stability, has been in the Research and Development Dept. of Socony-Vacuum Laboratories since graduation from Bucknell U. in 1939 with a B.S. in chemical engineering. He has the position of Senior Technologist in the Fuels Section, Product Division, and his major activity has been in the field of light products development and utilization. Mr. Cabal has been active in the Society of Automotive Engineers, and as a member of the Motor Fuels Panel of the Coordinating Research Council he has participated in storage stability and engine deposit studies conducted by that group for the U. S. Army Ordnance Corp.

He originally presented this material as a paper entitled "Factors Affecting Motor Gasoline Stability" at the Stability Symposium sponsored by Technical Committee A on Gasoline and Section A of Research Division V of ASTM Committee D-2, held in Philadelphia Feb. 15.

creased to 0.003 wt.-%, the peroxide number increased to 0.6 and the manifold deposits were 828 mgs.

This work was extended to evaluate the effect at a lower mercaptan level. The above blend was washed with caustic to reduce the mercaptan sulfur to 0.003 wt.-% before the addition of the same three antioxidants. The effect of aging these blends is also summarized in Table 1. As indicated, antioxidant *B* again promoted a reduction in mercaptan sulfur, increased peroxide formation and resulted in higher manifold deposits, although to a lesser degree than the higher mercaptan blends.

The deleterious effect of antioxidant sweetening noted above is not obtained with many stocks, although this cannot, to our knowledge, be predicted.

Effect of Phenols

Cracked gasolines contain varying amounts of phenolic compounds which are commonly designated as cresylic acids. Thiophenols, if present must be removed to prevent rapid ASTM gum increases. Other cresylic acids are frequently referred to as natural inhibitors because of their ASTM Induction Period response.

The graph on page 1045 illustrates that these materials contribute to manifold deposits. A pronounced increase in the manifold deposits was obtained by adding cresylic acids extracted from a catalytic cracked gasoline. The equivalent of 190 ppm. phenols increased the ASTM gum of the fuel 1.5 mgs./100 ml. However, the pentane insoluble manifold deposits were increased 469 mgs. As the manifold deposit weight equivalent to 1.5 mgs. ASTM gum is 227 mgs., the difference (242 mgs.) is the "condition of use effect" not predicted by the ASTM gum.

A much smaller increase was observed with the use of technical grade meta cresol. As indicated, approximately five times the phenol content employed above and in the same base stock only raised the pentane insoluble manifold deposit from 60 mgs. to 91 mgs.

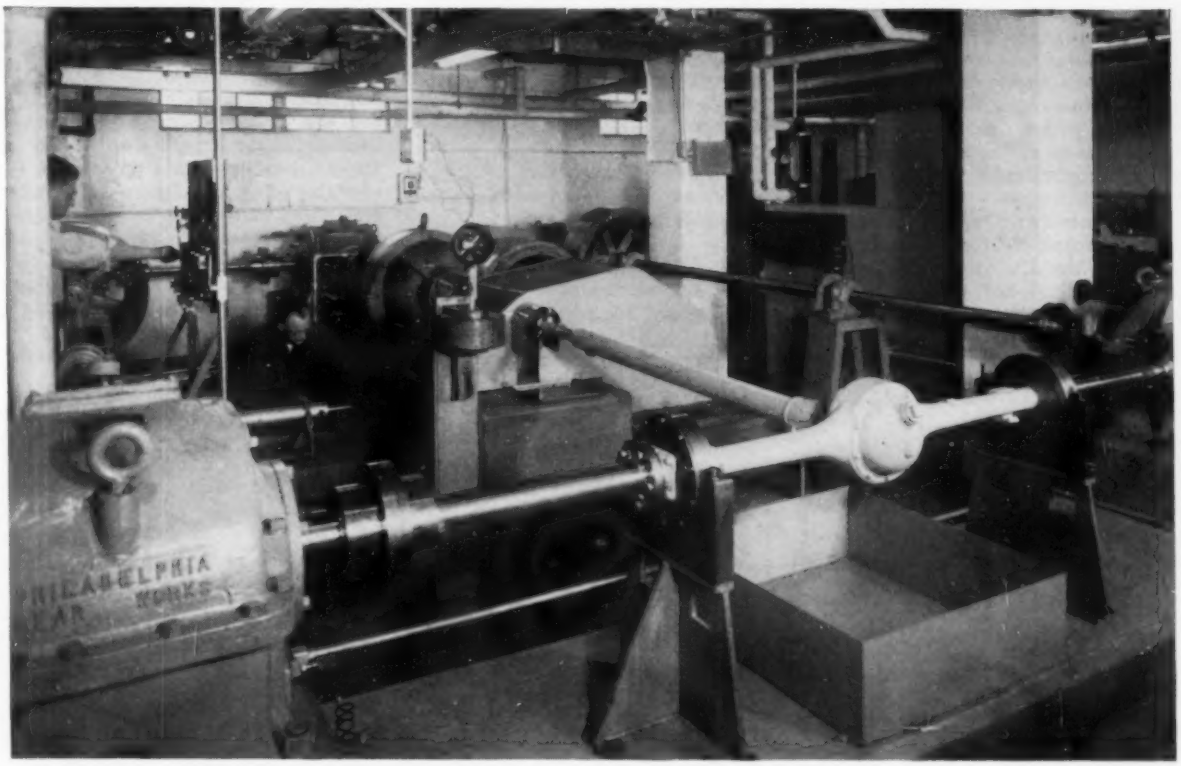
Although the Manifold Test is a useful procedure for laboratory studies it is impractical as a control test because of the time and fuel requirements involved.

Therefore there is a need for the development of an accelerated test procedure to predict stability under conditions of use.

Such a test will have to provide for: 1) intimate contact of fuel with air, 2) fuel residence as a liquid film on a heated surface, and 3) vaporization of fuel.

Some effort has been made in this direction by attempting to provide a uniform film of fuel on a heated cylinder. Evaporation rate was controlled by the temperature of the cylinder and the rate of air flow. Rather large differences have been observed between fuels when using 200 ml. samples, but to date the reproducibility is not considered satisfactory and better control of test variables is indicated.

NEWS in VIEWS



SIMULATED ROAD TEST unit for any standard vehicle axle, developed and in use at Beacon, N. Y., research laboratories of The Texas Co., permits detailed studies to be made of the performance of hypoid gear lubricants. Special design of such gears pose critical problems in lubrication at extreme pressures, and novel apparatus permits loading well beyond existing requirements. Loads are imposed on passenger car as well as truck axles.

HERE'S THE HOW OF

Catalytic Process Mechanics

By MARSHALL SITTIG
The Ethyl Corp.

CATALYTIC processes, particularly cracking, comprise a very large proportion of all petroleum processing operations. The reactions of fluids over solid catalysts are, in fact, of widespread importance throughout the chemical process industries.

In such reactions, the application of moving-bed and fluidized-bed techniques can result in better fluid-solid contact, more efficient heat transfer, and improved control of operating conditions. Although developed primarily for petroleum cracking,[17] these techniques are also finding application as basic chemical engineering tools—in fields such as steel manufacture, dyestuffs, and the cellulose industry.

The purpose here is to present a survey of the means of contacting fluid reactants with solid catalysts. Because the fixed-bed type of reactor is so well-known at this time, it will be discussed only in passing. A detailed discussion will be given on the essentials of adding the solids to the fluid, of solids transport, of the conduct of the reaction, and of disengagement of the solids from the fluid in moving-bed and fluidized-bed systems.

The three basic types of catalytic contactors can be compared on the basis of the size of particles handled.[15] Fixed-bed contactors contain catalyst particles which may range from 0.125 to 0.375 inches in diameter, and are supported on screens or trays. Moving-bed operations utilize catalysts in this same particle size range. Fluidized-bed operations, on the other hand, commonly use particles much smaller—from 0.0002 to 0.006 in.—although much larger particles, up to 0.25 in. or more, can be handled.

Adding Solids to the Fluid

Consider first the flow of granular and powdered solid materials in pipes and the introduction of such solids to flowing gas streams or into process vessels.

Solids Feeding Devices

Fig. 1 illustrates the various feeding devices which can be used in catalytic processing. In addition to these mechanical devices, seal legs can of course be employed without any valves.

The fundamental mechanisms of these feeders may be divided into several basic classes:

1—Variable opening at base of standpipe.
- a—Slide valve.
- b—Plug valve.

2—Disturbance of angles of repose of solids at base of standpipe.
- a—By gas jet.
- b—By rotation.
- c—By vibration.

3—Positive displacement.
- a—Reciprocating.
- b—Rotary.
- c—Screw-type.

Slide Valves: The slide valve is used at the bases of standpipes in commercial Fluid cracking units. The large open space beneath the hydraulically-operated gate prevents catalyst accumulations which might plug the slide. Such valves have experienced 2½ years of trouble-free operation with no plugging or binding. Such valves must be carefully designed to minimize erosion, however.

Plug Valves: Another type of gas-solids control valve is the plug valve developed for Orthoflow catalytic cracking units. These valves have spring-loaded seats, eliminating the need for expansion joints in the carrier lines. The design is unique in that a hollow stem is provided for injection of oil in the regenerated catalyst valve. The spent catalyst valve has a solid stem.

ICI Valves: A novel type of valve which has no moving mechanical parts has been developed in both England and the United States. It is known variously as the ICI valve or the "jet" valve. Figure 1, it relies on the angle of repose of the particular solid in the unfluidized state to halt flow. A jet of fluidizing gas disturbs this angle of repose and initiates solids flow.

Rotary Table Feeders: A rotary table feeder equipped with a variable-speed

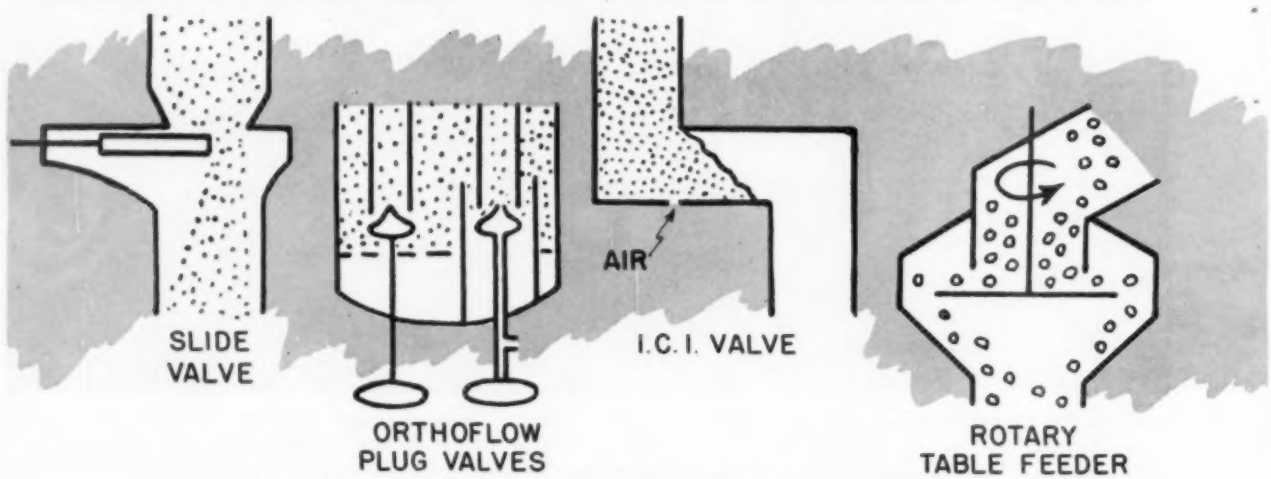


FIG. 1—(Above and on next page) Solids feeding devices used in catalytic processes

drive, this device has been adapted to the control of pebble flow in the pebble heater developed by Babcock and Wilcox Co. This device utilizes the natural tendency of the pellets to seek their angle of repose and jam the throat above the rotating table. The rotation disturbs this condition and causes flow at a rate varying with speed of rotation. A variation on this design substitutes vibratory motion for rotary motion.

Hypersorber Solids Valves: Special flow-control mechanisms have been developed by Union Oil Co. of California for their Hypersorption process. These are a solids flow control valve and a reciprocating-tray feeder. The solid-flow valve was designed to minimize attrition and to avoid any possibility of restriction by solids. Provision is made for disengaging sealing steam from the valve body to avoid alteration of the flow characteristics of the valve by surges of steam from the solids leg above the valve.

Reciprocating-Tray Feeders: The Hypersorber reciprocating tray mechanism provides a means for controlling the flow of granular solids uniformly across the entire cross-sectional area of a large conduit. It consists of a stationary feed tray, a moving displacement tray, and a bottom discharge tray. The openings in the feed and discharge trays are displaced so that one is sealed when the other is open.

Star Feeders: Star feeders offer the advantages of positive and controlled feed. A variable-speed drive may be used if desired. Rotational speeds of the order of 50 rpm are commonly used. Star feeders are not recommended for abrasive materials.

Screw-Feeders: A variable-speed, reversible helical screw may be employed to control the discharge of pellets or pebbles from a reaction zone to another reaction zone or to an elevator device. The rotation of this helical screw may be effected by a Selsyn motor in response to one of the significant operating variables, such as pebble temperature or gravity of the conversion products from the reaction zone.

Centrifugal Solids Pumps: A centrifugal pump for finely-divided solids may be used for a pressure differential of 10 to 100 psi[20] Such a pump is operated at about 1000 rpm, and operation substantially without erosion is claimed.

Flow of Solids in Pipes

To introduce the powdered or granular solids to one of the feed devices described above, it is generally necessary to consider the flow of dense-phase solids or settled solids in pipes—from feed hoppers or from solids-recovery equipment elsewhere in the plant.

General rules for the flow of particulate solids in pipes as summarized by Gregory[6] are as follows:

1. The internal diameter of the conduit should exceed by 5-7 times the diameter of the largest particles where they are present in high proportion.
2. Material of narrow size range flows best; wider size ranges exhibit increasing tendency to stick.
3. Fine material, below 0.003 inches, tends to stick.
4. Surface moisture should be kept below 1-2%.
5. Mild steel pipe causes sticking more readily than stainless steel or glass.

Newton, Dunham, and Simpson have developed an equation for the nonfluidized flow of granular solids in conduits which shows that the head of catalyst has little effect:[13]

$$F = 8.50\ D^{2.96}\ H^{0.04}$$

or $$f = 10.8\ D^{0.96}\ H^{0.04}$$

where F = catalyst flow in lb/min.
D = orifice diameter in inches.
H = head in feet.
f = catalyst flow in lb/min/sq in.

The formula holds when the orifice diameter is greater than six times the particle diameter. Below this, flow was very irregular. This equation compares with that presented by Gregory[6] for stick-slip flow of fluidized solids:

$$F = 16.67\ D^{2.5}$$

Flow orifices installed in 45° sloping lines with eccentrically-drilled holes tangent to the bottom of the pipe may be used to control the flow rates of granular solids. Thus, for either bead or pellet catalyst, the following rates may be maintained:[10]

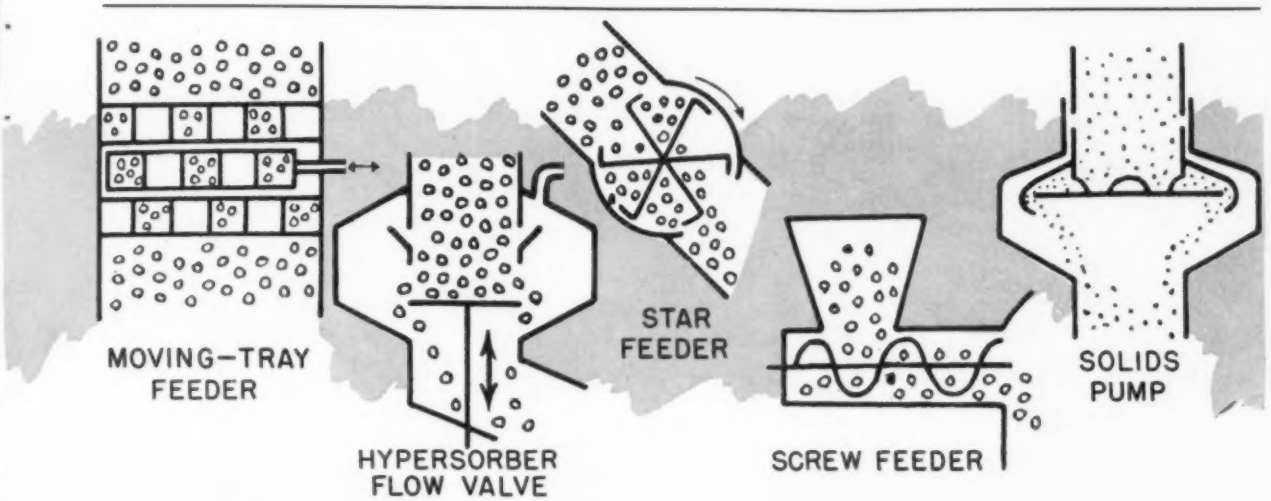
Orifice Size Inches	Flow Rate—Tons/Hour
2	2
3	6.5
4	14.3

These data fit the equation:

$$F = 9.37\ D^{2.84}$$

With fluidized solids, the flow rate from the base of a standpipe is proportional to the square root of the fluid head, as with a true liquid.

Flow rates in catalyst lines in Thermofor cracking plants are of the order of 1 to 2 ft/sec. Vertical downward velocities in kilns and reactors are of the order of 6 to 12 in/min. In contrast, flow rates in dilute-phase fluidized conveying lines are 15-40 fps., and vertical downward velocities in dense-



phase fluidized standpipes fall in the range of 2-7 fps.

Design of Gas-Solids Mixing Point

Farbar[4] has emphasized the importance of the design of the solids-mixing nozzle. The presence, location, and type of such a nozzle influence solids flow as well as rate of solids feed. Simply dropping the solids into the air stream in a tee results in operating difficulties at all solids and air rates.

Solids may be introduced as a slurry, eliminating the problems of sealing a column of solids, but introducing erosion problems. The Suspensoid catalytic cracking process is an outstanding application of the introduction of solids as a slurry. A special triplex slurry charge pump is used; this has a gland seal to prevent lodging of catalyst in the packing.

Where the charge is in liquid form, it may be introduced directly to a bed of solids, as in liquid-feed Thermofor cracking, and as in some Fluid cracking units.

Transporting the Solids

The various methods of solids transport are summarized in Table 1.

Table 1—Comparison of Three Methods of Solids Conveying

	Bucket Elevators	Gas Lift	Hyperflow
Power requirements (for elevation to top of cracking units)	17.5 hp and 100 ton/hr	250 hp and 400 tph.	—*
Solids velocities	20-120 fpm	15-40 fps.	Low
Pressure differential required	None	Low	High
Amount of lift gas required	None	Large	Small**
Attrition loss	Lowest	0.15 tpd makeup 150 tph. circ. (in lift operation alone)	Low
Investment cost	High	Low	—*
Adaptability to high temperature operations	Poor	Good	Good
Adaptability to high pressure operations	Fair	Fair	Fair
Rates of solids transport	500 tph max. (in commercially available units)	400 tph (in a 27-in. lift pipe)	750 tph. (in a 12-in. line)

* No commercial data available.
** At operating conditions.

Pneumatic Conveying

The dilute-phase pneumatic conveying of finely-powdered solids is a vital part of the solids circuit in fluid catalytic cracking.

Following a paper by Vogt and White,[19] further papers were presented by Hariu and Molstad[7] and by Farbar[4] at a Symposium on Fluidization held at the Massachusetts Institute of Technology in December, 1948.

Hariu and Molstad concluded that pressure drop in a vertical riser, through which solid particles are being transported, is the sum of:

1—Pressure drop due to gas flow alone as if no solids were present, and

2—Solids pressure drop consisting of:

a—Solids static head equal to vertical distance times dispersed solids density.

b—Solids friction loss due to contact of particles and pipe wall. The Fanning equation, used with solids linear velocity and dispersed solids density, is recommended here.

c—An acceleration pressure drop. This is a factor for a considerable distance above the point where the solids begin to move vertically, and is a significant portion of the total pressure drop.

Farbar has studied conveying in horizontal pipes and found a tendency to independence of pressure drop with

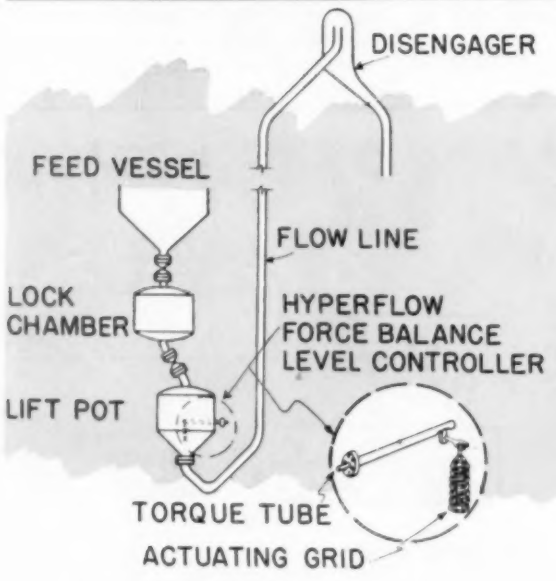


FIG. 2—Solids flow in the Hyperflow technique

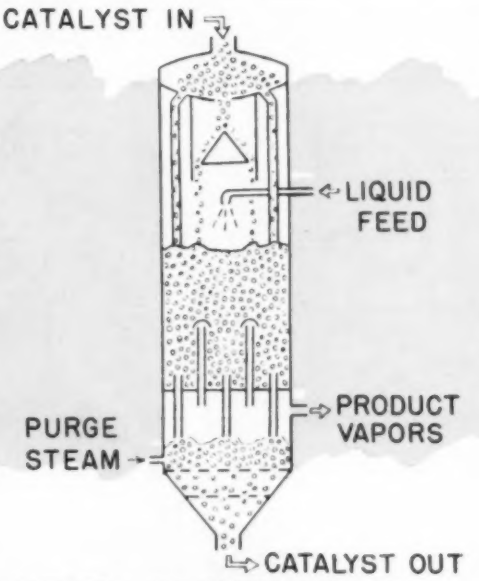


FIG. 3—The Thermofor solid-bed type of reactor

respect to solids loading at high loadings. Also, a decided centrifuging effect was found to occur at bends. A distributing vane in the downstream end of an ell reduced this effect, which was particularly harmful from the standpoint of erosion.

Belden and Kassel have published data on the conveying of large catalyst particles (from 0.04 to 0.08 inches in diameter) in vertical transfer lines.[2] A tentative pressure drop correlation is presented where the pressure drop is a combination of a static drop based on actual particle density in the transfer line and a friction term which involves particle mass velocity but is independent of particle diameter and density.

In the air-lift Thermofor catalytic cracking unit of Magnolia Petroleum Co. at Beaumont, Texas, from 100 to 500 ton/hour of catalyst are lifted 270 ft in this plant. Air requirements are 12,000 scfm at 2 psig at the lift pot.

The air supply to the lift is split two ways. Catalyst enters the lift pot by way of lines from different segments of the kiln, except in small units where a single line suffices. The mechanics of this system are somewhat simplified in larger units by the fact that the kiln is doughnut shaped with the lift pipe rising through its center. Low air velocities and streamlined design make wear plates unnecessary in the lift system.

Bucket Elevators

A typical catalyst elevator in an old-style TCC unit may be 200 ft high and, in a 10,000 b/d unit, must handle about 100 tons of catalyst per hour. A double chain is used with a continuous line of buckets mounted between the chains. The buckets are constructed of 10-gage heat-resistant alloy steel. The bottom chain sprocket is mounted on a walking beam to allow for expansion (up to 16 inches). Since the elevator casing is held under several inches of flue gas pressure, the lower shaft carries a conventional packing gland in a ground seal plate which is held against a packed frame by spring pressure.

The elevator is protected by brakes against counter-rotation in the event of power failure. The elevator sprocket shafts are water-cooled. A volatile oil containing about 30% of fine graphite has been used successfully for lubrication of the sprocket teeth and chain at the service temperature of 900° F; the oil vaporizes without residue, leaving the graphite as the effective lubricant.

In some more recent units, a traction drive has replaced sprockets. Now, wear is distributed around the surface of the traction rim instead of being concentrated locally at the sprocket teeth.

The mechanical complexities of hot-catalyst elevators and their inability to handle high catalyst circulation rates have resulted in their replacement in most newer units with air lifts or gas lifts.

It has, however, been stated that the efficiency of the bucket elevator is high, as compared to other methods of moving the catalyst. Thus in a 100-ton/hour installation, of 40 installed hp, 29.1 hp were consumed by the spent catalyst elevator. Of this, 17.45 hp were used in actually lifting the catalyst, giving an efficiency of 60%.

Flow-rate indication is provided by calibration of wattmeters in the control house which show elevator power consumption as a function of weight transported.

The useful life of catalyst elevator chains has been given as in excess of three years.

Hyperflow

The Hyperflow technique, as developed by the Union Oil Co. of California and described by Berg,[3] is claimed to have the following advantages:

1—Minimum breakage of solids.

2—High rates of solids transport in small size equipment.

3—Low investment cost.

4—Low maintenance and operating costs.

5—Easy adaptation to high-temperature and high-pressure operation.

In operation, the solids are moved in a compact, unfluidized mass. The essentials of Hyperflow are shown in Fig. 2.

Molten-Metal Lifts

According to the patent literature, molten lead or liquid mercury may be used to lift catalyst, eliminating mechanical elevators and, at the same time, providing a gas-tight seal between reaction and regeneration zones according to Reed, Schutte, and Bowles.[14] Molten lead is preferred:

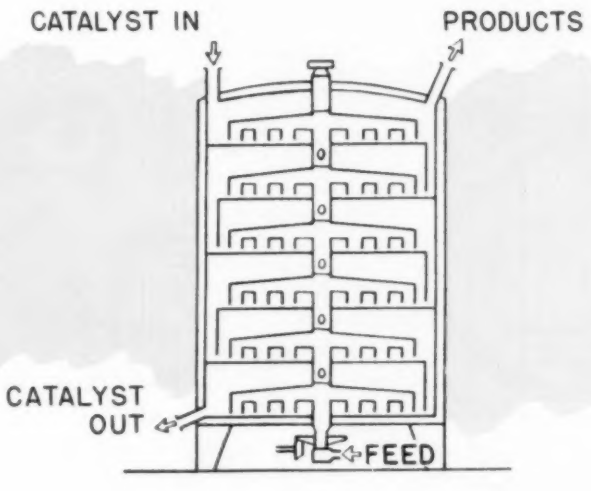


FIG. 4—Multiple-hearth is also moving-bed type

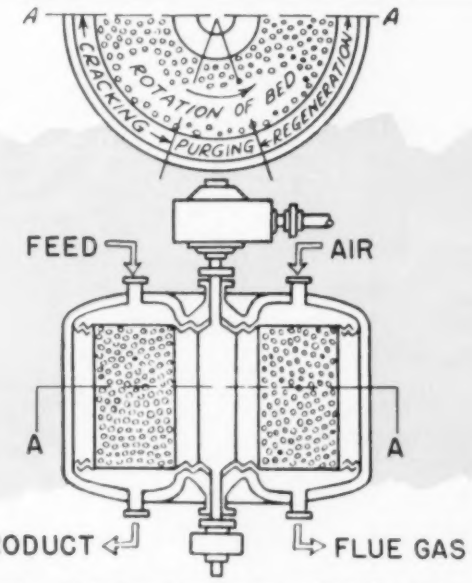


FIG. 5—"Grindstone" reactor has reached pilot stage

1) because of its high density, which makes necessary only small seal legs; 2) because it will not wet the catalyst nor react with it; and 3) because of its low vapor pressure at 800-1000° F. The molten lead is pumped past a catalyst pickup point to a disengaging chamber and back again in a closed cycle.

Conducting the Reaction

Moving-Bed Reactors

Early TCC reactors were baffled vessels. Catalyst development had not proceeded to the point where other designs could be considered. Pelleted clay catalyst entered the top of the reactor through a series of distribution pipes and flowed down, over, and through a series of perforated catalyst flow plates.

This baffle system did not permit the catalyst volume to be varied satisfactorily, so the "solid-bed" reactor illustrated in Fig. 3 was developed. The advent of more rugged bead catalysts permitted adoption of the solid bed design and its operation on liquid charge stocks without prior vaporization.

In the concurrent-flow solid-bed TCC reactor shown in Fig. 3, liquid hydrocarbon feed is introduced through a fog nozzle. About 80% of the catalyst falls in an annular curtain surrounding the fog nozzle. The remaining 20% is introduced through a peripheral row of feed pipes whose length fixes the bed level.

This concurrent flow configuration has advantages over the earlier countercurrent flow units in that:

1—The heat contents of inlet oil and catalyst streams are better utilized —giving a closer approach to an ideal isothermal condition. This produces higher bed temperatures for given oil and catalyst inlet temperatures.

2—Greater throughput may be achieved in a given reactor area.

A cylindrical rotary-kiln type of catalytic contactor has been described by Tusson.[18]

A multiple-hearth type of catalytic reactor with the charge stock coming up the hollow central axle and out the rake arms has been patented by Funsten.[5] A reactor of this type is shown in Fig. 4. Such a reactor has the advantages of low pressure drop due to arrangement of beds in parallel, and of positive movement of catalyst through the reactor.

One variety of moving-bed catalytic cracking process uses the "grindstone" reactor shown in Fig. 5. This process has been operated on a substantial pilot-plant scale by Sinclair Refining Co.[9] The apparatus is similar to a Ljungstrom air preheater in that the rotor passes through various zones in sequence. Here, the pie-shaped catalyst bed segments pass through reaction, stripping, and regenerator zones. This reactor has not been used commercially for lack of a sufficiently effective annular seal.

Fluidized-Bed Reactors

A wide variety of contacting vessels has been developed for the conduct of the fluidized solids process. A recent development which has often been credited as the forerunner of present day fluidized-solids process is the Winkler process for the gasification of brown coal, which was developed in Germany about 1925.

The initial application of fluidized solids to petroleum cracking in the United States, in 1941, involved the upflow reactor design. Here the gas-solids mixture entered at the base and, after passage through the enlarged reaction zone, were taken overhead, where 100% of the solids were separated from the products in dust collection equipment. These upflow reactors had several disadvantages, however:

1—The solids recovery problem was of large magnitude.

2—The support structure was high because of the pressure drop in the fluidized solids stream.

3—Control of solids holdup was not easily achieved.

4—External solids hoppers were necessary.

These disadvantages were overcome by the development of the downflow (dense-bed) type of contactor illustrated in Fig. 6. Here the solids-recovery cyclone is incorporated within the process vessel.

The evolution of the fluidized solid units now in use in the petroleum industry has been the product of intensive research and development by the Standard Oil Development Co., the Universal Oil Products Co., the M. W. Kellogg Co., and others. Details of

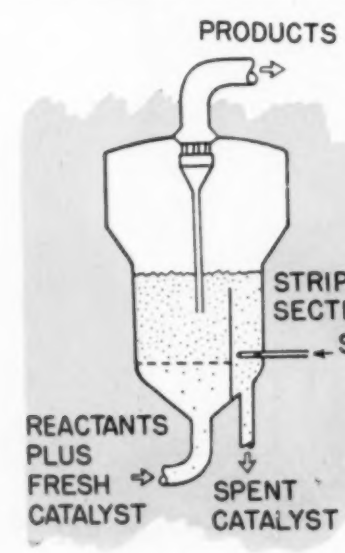


FIG. 6—Downflow, "boiling-bed" type

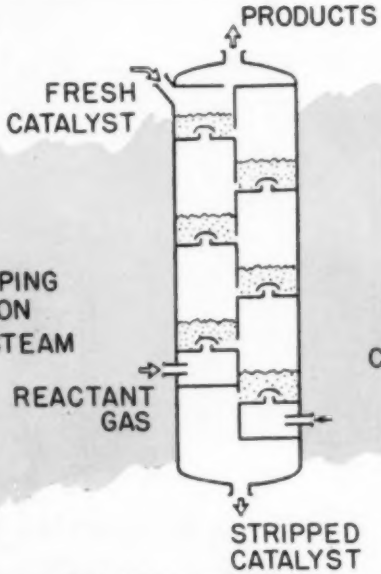


FIG. 7—Countercurrent reactor

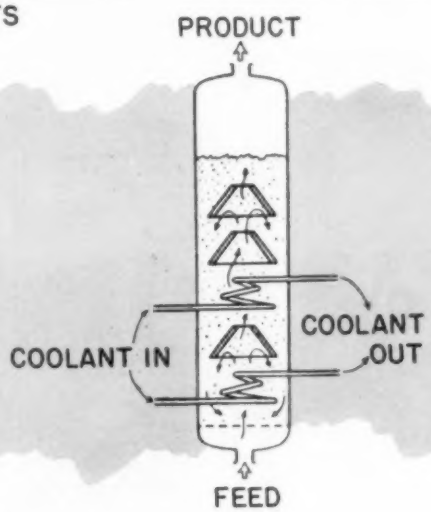


FIG. 8—A baffled reactor

the evolution of the Esso units from Model I to Model IV have been covered elsewhere in the literature.[12] [17]

The back-mixing which occurs in shallow, wide fluidized beds is often very disadvantageous from a process standpoint. Where true countercurrent operation is desired, a series of fluidized beds may be used, much resembling a bubble-plate fractionating column as shown in Fig. 7.

With heavy catalyst or in small-diameter tubes, the provision of baffles, such as disc-and-doughnut baffles, and helices may be helpful in providing uniform fluidization. A possible design for a baffled reactor is shown in Fig. 8. It is interesting to note that stationary helices may also be used to promote contacting in moving granular beds, as discussed by Beckberger.[1]

Vessel Arrangements

Since in catalytic processing it is frequently necessary to regenerate the catalyst, a separate regeneration vessel is necessary. Then comes the problem of combining the elements of solids conveying, solids feeders, and reactors into a workable plant design.

Moving-Bed Processes: The history and evolution of the moving-bed process have been discussed previously.[16] Vessel arrangements in moving-bed petroleum cracking offer an interesting study in possible combinations, as shown in Fig. 9.

A moving-bed process of an unusual nature has been patented by Phillips Petroleum Co. In this process, a combustible catalyst support such as charcoal, coke, or sawdust is fed into a tumbling drum where it is sprayed with the catalyst in slurry form. The wet particles then fall countercurrent to hot air and thence into the reactor. The catalyst is withdrawn from the base of the reactor. Catalyst regeneration may be avoided or simplified by the use of this unique form of catalyst.

Fluidized-Bed Processes: Fig. 10 illustrates the chronological evolution of fluidized-bed hydrocarbon cracking units. The trend has been toward lower support structures, smaller process vessels, streamlined piping, and improved stripping. The model numbers given (II, III, IV) are designations applied by the Standard Oil Development Co.[12]

As an example of a radically different configuration, and to illustrate the manifold varieties of unique vessel arrangements which are possible, consider the design in Fig. 11. For comparison with the units shown in Fig. 10 (all of about 10,000 b/d capacity), this design takes the shape of a horizontal cylindrical chamber about 30 ft in diameter and about 50 ft long for a 10,000 b/d plant. There are no standpipes or valves, catalyst wells having been substituted for standpipes, and lift-gas injection to these wells giving valveless control.

The Suspensoid Process: The Suspensoid cracking process as developed by Imperial Oil Co. and installed at their Sarnia, Ontario, refinery represents a type of solids contacting operation which is worthy of brief mention.

It can be characterized as an extremely dilute-phase fluidized-solids operation, since the catalyst-to-oil ratio by weight is less than 0.05, as compared to 5-15 in conventional "dense-bed" reactors. The catalyst is simply slurried with the oil feed and pumped to the coils of a fired heater. Complete vaporization of the charge is essential to decrease coke formation.

Furnace-coil erosion is no more severe than in conventional thermal cracking furnaces, but erosion at the pressure control point after the fired coil was excessive. Here, a pressure release valve was replaced by a simple converging orifice discharging directly into a flash chamber. In a later "Super-Suspensoid" operation, higher furnace coil velocities made necessary streamlined headers and replaceable collars to protect the last three inches of each tube.

Catalyst is removed from the bottoms from the flash chamber by an Oliver pressure rotary filter, operating with flue gas in the filter jacket. A special gland fed with clean oil is used to keep the clay catalyst out of the filter shaft bearing surfaces.

Similar processes have been the objects of study by other groups. A patent[8] by Holland covers a similar process.

Heat Exchange

Heat exchange in both moving-bed and fluidized-bed reactors is superior

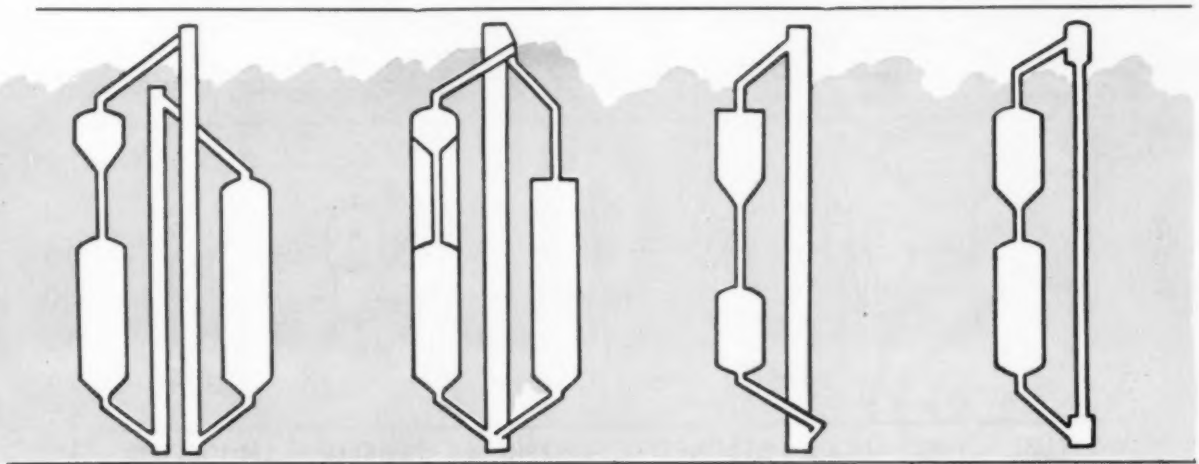


FIG. 9—Vessel arrangements used in moving-bed processes

to that in fixed-bed units, as discussed early in this paper. Also, the good heat transfer characteristics of moving and fluidized beds offer a broad range of possibilities to the design engineer. These include:

1—Placement of heat transfer tubes within the bed for heat supply or removal at high rates.

2—Circulation of catalyst through external exchangers for reheat or for heat removal.

3—Direct combustion within the catalyst bed. Actually, this technique has been applied primarily to noncatalytic processes. Examples are Thermofor Pyrolytic Cracking (moving-bed) and Fluo-Solids calcining.

4—Liquid injection to bed with heat removal by evaporation. This may be utilized simply as a means for vaporization of liquid feed or may be employed as a temperature-control device.

5—A separate noncatalytic solid may be employed as a heat-transfer medium. Thus, an auxiliary solid (firebrick, iron shot, aluminum pellets, sand, metal oxides, or coke) may be used in a fluidized hydrocarbon synthesis reactor. Such a material is preferentially withdrawn from the reactor, cooled, and returned to the reactor.

Erosion

Erosion in fluidized solids plants is controlled and minimized by:

1—The proper choice of gas velocities.

2—Streamlining of parts jutting into fluids streams (e.g. thermocouples and gas distribution grids).

3—Streamlining of piping by the use of sweeping bends.

4—The use of easily-replaceable protective wear plates.

It is interesting to note that experimental work has been reported on impingement of solids in air onto black iron and gypsum plaster targets. The linearity of a plot of plaster-to-iron erosion ratios suggests the possibility of predicting iron erosion rates from measurements on plaster models.

Very little trouble has been encountered with erosion in moving-bed cracking plants. In sloping catalyst lines, vertical baffles may be installed at intervals so that a layer of stagnant catalyst remains in the bottom of the pipe, protecting it from erosion.

Instrumentation

Level measurement in beds of granular solids is important because it affects inventories in hoppers and, more important, because it indicates the height of the solids bed in a reactor.

In hoppers, a rotating shaft may be used which bears paddles at its lower end and is so mounted that the paddles ride on the catalyst-bed surface. A second type of level indicator consists of a series of pressure-sensitive switches on the side wall of a vessel, such that the level may be located as being between a given pair of switches. Alternately, the entire hopper may be spring mounted and the deflection measured to indicate catalyst content. Capacitance probes may also be used to locate levels in beds of granular solids. A recent development involves the measurement of bed depth in a TCC reactor as a function of absorption of radioactive rays. A source is located below the bed and a receiving counter above the bed.

Another device of interest is the Hyperflow Force Balance level transmitter which can be used to indicate or control solids level in beds of granular solids. The grid actuating element is constructed integrally with a conventional torque tube mechanism employing an air pilot and actuating pneumatic control system. The solids level control actuating grid may be varied to meet the particular force and sensitivity response characteristics required. Thus, parallel vertical planes of wire mesh may be used as an alternate to the cylindrical grid.

Level measurement in dense fluidized beds simply consists of measurement of the pressure differential across the bed.

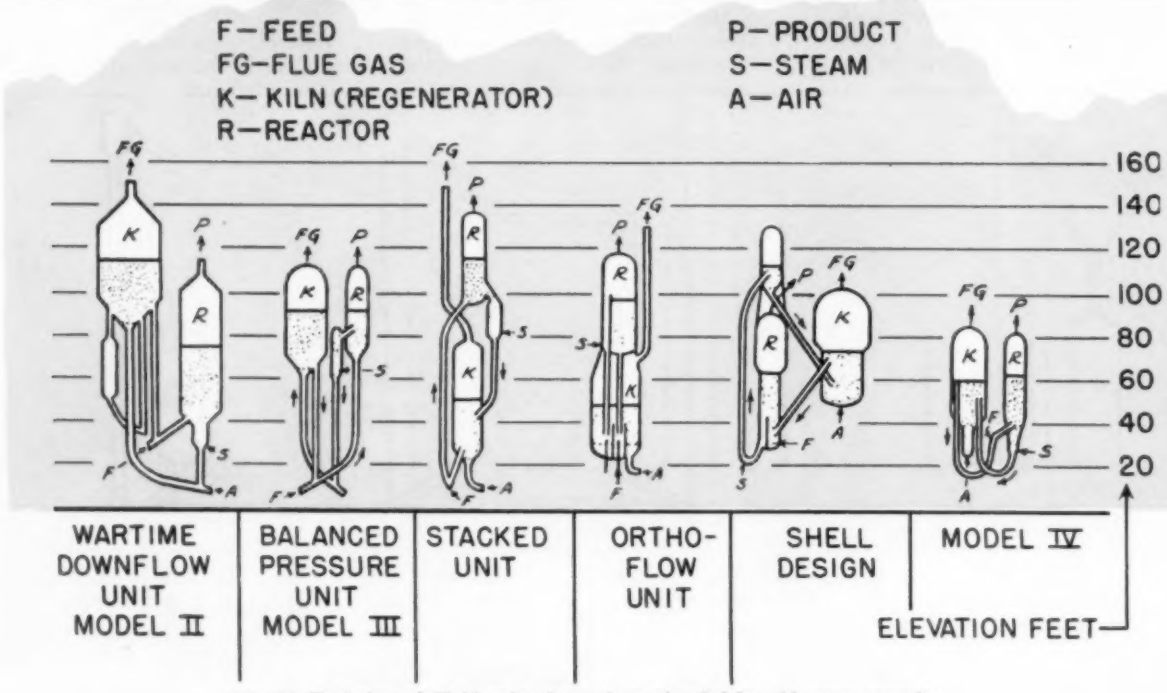


FIG. 10—Evolution of Fluid units shows decreasing height with same capacity

Flow measurement in fluidized-solids mixtures can be made by the use of orifices and pressure-drop measurements.

Flow measurements in moving-bed processes are achieved by relation to elevator-power consumption when catalyst elevators are used. Also, an "inverse" rectangular weir may be used in sloping feed pipes, a low weir level indicating a high flow rate from the feed pipe.

Disengaging the Products

Extreme fines are undesirable within the process because of tendency to plug equipment. Efficient recovery of fines, particularly of expensive catalysts is very important. Also, product removal from the catalyst by stripping must be carefully considered in plant operations.

Leva points out[11] that the causes of fines formation by catalyst-particle disintegration are:

1—Development of internal stresses due to thermal gradients.

2—Composition changes, such as carbon deposition in hydrocarbon synthesis catalysts.

3—Mechanical attrition.

Moving-Bed Units

In TCC units, fines are eliminated by passing about 5% of the catalyst circulation through an elutriator. All material finer than 14-mesh is removed by a countercurrent flue gas stream at 17 ft./sec.

The separation of the gaseous products from the granular catalyst is generally accomplished in disengaging sections. Here the catalyst is flowed over convex surfaces (inverted-V sections or "umbrellas") with gas removal from beneath the convex surfaces, or the catalyst is passed through a plate containing a number of catalyst downcomer pipes with vapor removal at the root of the pipes beneath the plate. A combination of these designs is shown in Fig. 3.

Fluidized-Bed Units

In fluidized solids processing, most commercial units employ a combination of cyclone separators and Cottrell precipitators to disengage the catalyst from the gaseous products. The design trend has been from external cyclones to multiple cyclones installed within the process vessels. The elimination of Cottrell precipitators in recent units has been a product of careful design combined with the development of improved microspheroidal catalysts.

Scrubbing the effluent products from fluidized solids systems with the liquid feed material may be utilized. Thus, heat and catalyst may be simultaneously recovered from the effluent gases.

Interestingly enough, both moving and fluidized beds are being developed for dust removal from effluent gas streams from catalytic units.

In pilot-plant units, porous ceramic or metallic filters are generally used. A bank of such filters are employed, with automatic or manual valving such that they may be blown back and cleaned in rotation.

Conclusion

It has been the purpose of this brief review to high-spot some of the mechanical devices available to the engineer who is interested in the conduct of catalytic processes. An amazing amount of ingenuity has already been reflected in the development of these processes to date, and the versatility of both moving-bed and fluidized-bed techniques presents a definite challenge for future development.

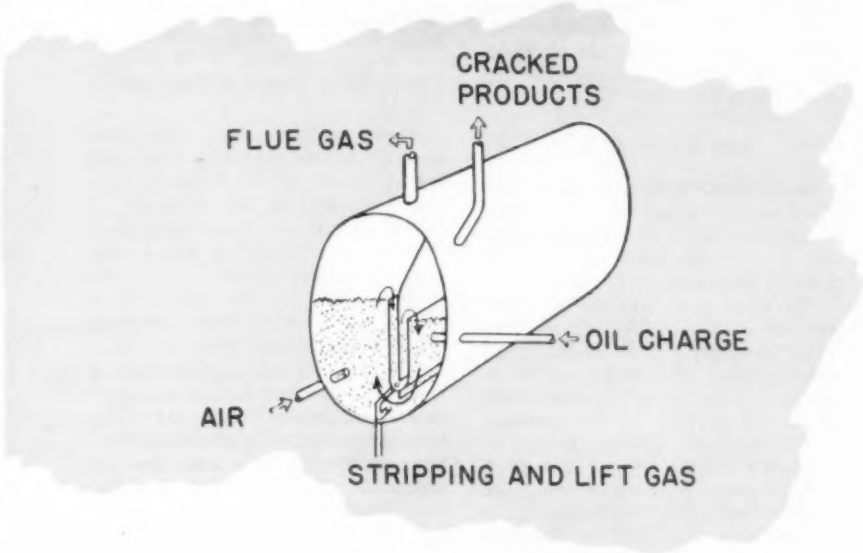


FIG. 11—Unusual valveless single-vessel fluidized-bed unit

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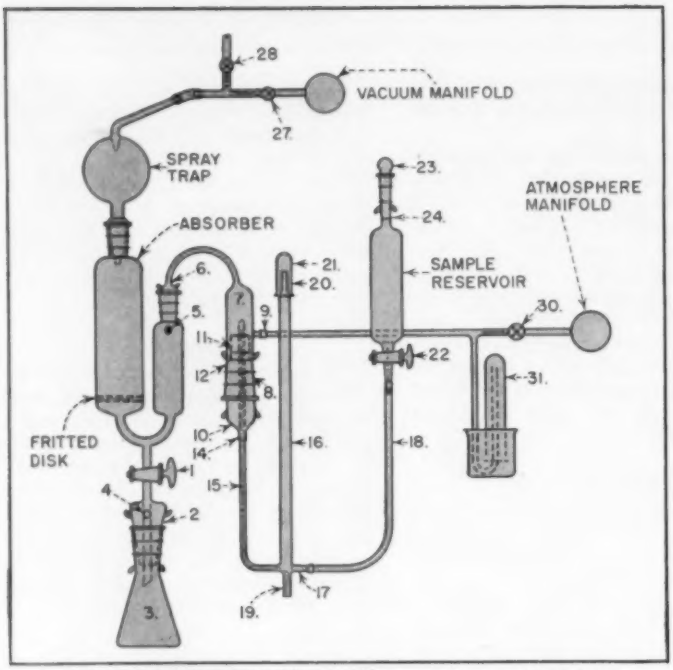


FIG. 1—NEW DESIGN of lamp sulfur apparatus modified from ASTM D90-50T

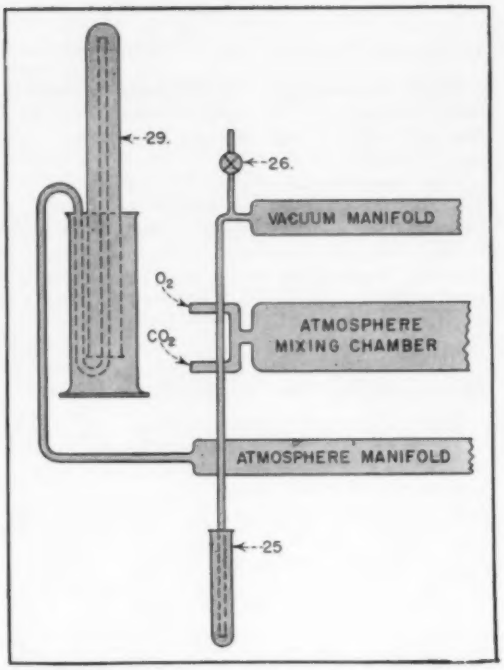


FIG. 2—MANIFOLDS for vacuum and artificial atmosphere for combustion control

Improved 'Universal' Lamp Sulfur Apparatus

By C. HOWARD HOPKINS, Skelly Oil Co.
Research & Development Dept., Pawhuska, Okla.

IMPROVED apparatus for the determination of sulfur in petroleum products has been developed in the laboratories of Skelly Oil Co. It is a modification of the standard ASTM apparatus for the Lamp Sulfur method (D90-50T)[1] and was developed with two primary aims—to extend the range of samples which could be analyzed by the lamp method in one basic apparatus design, and to provide more adequate controls over every phase of the sample combustion.

In line with these aims, the improved apparatus has three distinct advantages over existing apparatus:

- A wider range of petroleum distillates can be burned by means of this apparatus, extending from LPG through medium gas oil.
- A greater degree of control can be exercised over the inherent variables in this analysis, resulting in cleaner burns, smoother operation during every phase of sample combustion, and (in some cases) larger volumes of sample consumed.
- Operation of the apparatus is easily learned, even by inexperienced personnel, and once set in operation it can be maintained at optimum performance with a minimum of attention, thus freeing the operator for other duties.

THE APPARATUS

The absorber and spray trap used in the modified apparatus are the same as described in ASTM Method D90-50T,[1] with the following modifications, as illustrated in Fig. 1:

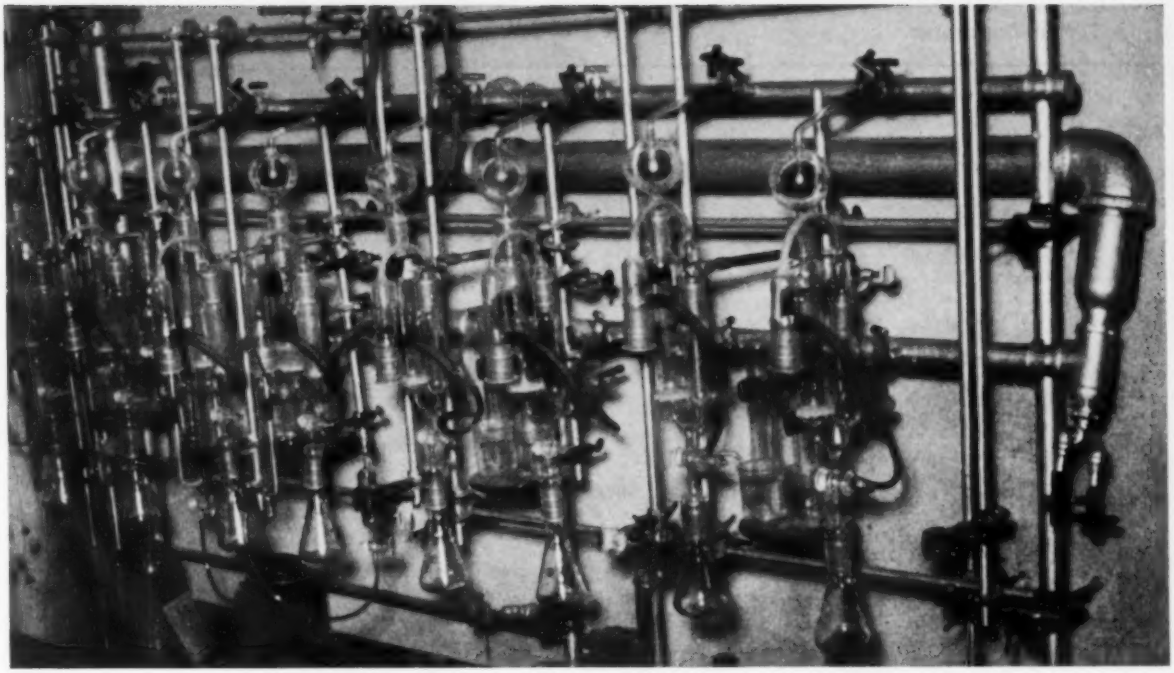
The usual glass footing has been replaced with the stopcock and receiver assembly, *1*, *2* and *3*. The tapered ground joints shown are 24/40 and an 8 mm. straight-through tube carries the contents of the absorber into the receiver. Breather tube *4* is provided above the tapered inner joint so that drainage from the absorber can be unobstructed. Spring hooks have been added at *5* to hold the combustion chamber securely in position while inserting the lamp.

The chimney is connected into the smaller of the absorber arms by means of a tapered 24/40 inner joint, *6*. A 9 mm. inverted U-tube connects this joint to combustion chamber *7* and combustion chamber adapter *8*. This adapter is a tapered 29/42 outer joint. The atmosphere inlet tube *9* is a 1 in. length of 8 mm. tubing sealed into the combustion chamber at a position slightly below the top of flame cooling coil *11*.

Burner adapter *10* is constructed from a tapered 29/42 inner joint, with a 1 in. length of 8 mm. tubing accurately centered as shown at *13*. A 1¼ in. length of rubber tubing *14* is slipped over the end of this 8 mm. glass tubing, leaving about ½ in. protruding below it, thus providing a simple and effective slip-seal between the lamp and the adapter.

Flame-cooling coil *11* is constructed from the "YLS" coil used in the apparatus of Edgar and Calingaert.[3] The heat-dispersing rod originally on it has been replaced with a split stainless steel collar *12*, into which the coil has been brazed. This collar fits snugly into the top of the tapered 29/42 inner joint of the burner adapter and provides spring tension for holding it securely in position.

The lamp consists of the wick tube *15*, the sample tube *16*, the sample in-



BATTERY OF EIGHT lamp sulfur burners in Skelly's research laboratory

Offers Wider Sample Range, Closer Control

let tube *17*, the solid rod footing *19*, and the constricted top of the sample tube *20*, which is covered with a small test tube *21*. The sample inlet tube is connected to the sample reservoir by means of an 18 in. length of "Tygon" tubing *18*.

The wick tube *15* is 5 mm. O.D. and 10 in. total length, bent as shown and packed with braided wick (W. H. Curtin Co. No. 16484S). The sample tube *16* is 10 mm. O.D. and 12 in. long from footing to constriction. The sample inlet tube *17* is a 1 in. length of 5 mm. tubing, sealed into the sample tube directly opposite the wick tube. The footing *19* is a 1 in. length of 7 mm. rod, and is used primarily as a support for the lamp during the preliminary and final stages of a sulfur determination.

The sample tube of the lamp is uncalibrated and performs the function of providing the proper sample level for every stage of the sample combustion. The top of the sample tube is constricted with a 1 in. length of 8 mm. tubing *20*, so that a rubber bulb may be used in forcing sample up the wick tube.

The sample reservoir was constructed from a 25 by 150 mm. test tube which holds a minimum of 30 ml. of sample. This volume is not critical. The reservoir is uncalibrated except for the single reference mark on the narrow part of the neck at *24*. The tubing below stopcock *22* is drawn into a tip so the "Tygon" tubing which connects it to the lamp may slip over it easily. A calibrated reservoir may be substituted for this design, if desired, but this is unnecessary.

Vacuum for this apparatus is provided by a suitable vacuum pump and goes through a 15 gal. surge drum to the vacuum manifold, Fig. 2. The vacuum upon the manifold is maintained at about 80 cm. (31 inches) of water as indicated by the vacuum manostat *25*. It is closely controlled at this value by means of the side-arm bleed valve *26*.

The vacuum upon each burner unit is accurately regulated by means of needle valve-bleed valve combination *27* and *28*, Fig 1.

Oxygen and carbon dioxide flow to the artificial atmosphere mixing chamber and manifold (Fig. 2) may be controlled by any suitable means, such as pressure regulators equipped with suitable-sized orifices, rotameters, or flowmeters. The pressure upon the atmosphere manifold is maintained at about 25 cm. (10 in.) of water as indicated on the open-bottomed manostat, *29*. This manostat also serves as a pressure relief valve for the atmosphere supply system.

The atmosphere supplied to each burner unit is carefully controlled by needle valve *30*. The pressure differential existing within the combustion chamber, *7*, is measured by means of a short water manostat, *31*, and can be very closely controlled to produce the optimum flame characteristics.

An LPG lamp capable of operating with the existing low-pressure, low-velocity atmosphere has been designed, and is shown in Fig. 3. The sample inlet is at *32*, and the atmosphere inlet at *33*. A separate chimney is required as an adapter between the lamp and the absorber. It differs from the previously-described chimney in requiring no atmosphere inlet tube and uses a tapered 24/40 outer joint as the lamp adapter.

The LPG burner proposed by ASTM Technical Committee "H" on Light Hydrocarbons[2] can be adapted for use with this apparatus, insofar as apparatus design is concerned. However, it appears to require a higher

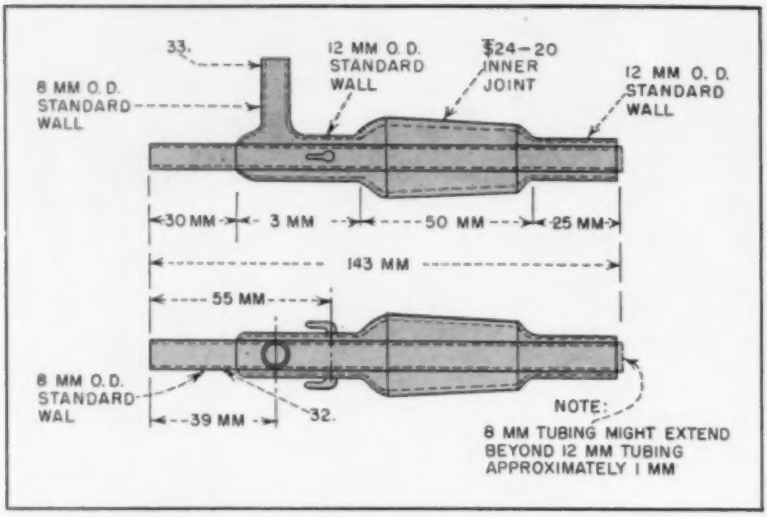


FIG. 3—DETAILS of modified LPG lamp for low pressure—low velocity atmosphere

pressure and velocity of supporting atmosphere than is normally maintained in the atmosphere supply system of this apparatus, and cannot be used successfully under this circumstance.

ITS OPERATION

Selecting the proper lamp for a given sample is of the utmost importance in this analysis. The lamps are separated into three grades based upon the relative porosities of the wicks—"Dense," "Medium" and "Fast"—and used, respectively, for light, intermediate and heavy distillates. Special lamps were made in addition for the burning of pentanes and of pentane-hexane mixtures, in which the wicks were recessed 0.5 to 1.5 in. from the tip of the wick tube.

The absorber solution which has been found to give the most consistent volumetric vs. gravimetric results in lamp sulfur determinations is 10.0 ml. of 0.0624 *N* sodium carbonate plus 20 ml. of 3% hydrogen peroxide.

Upon adding solution to the absorber, the spray trap is connected to the vacuum manifold as illustrated in Fig. 1. Bleed valve *28* is fully opened, then needle valve *27* is opened until a slow stream of air starts bubbling through the solution. Bleed valve *28* then is closed until the proper air-flow through the solution has been attained. Then a glass stopper is inserted into the combustion chamber adapter, *8*, the needle valve on the atmospheric manifold, *30*, is quickly opened and adjusted to produce atmospheric pressure in the combustion chamber, *7*, as indicated by the manostat, *31*.

The lamp and "Tygon" tubing are wetted by the sample, then drained free of surplus liquid. The sample reservoir is filled to reference mark *24*, the "Tygon" tubing, *18*, is connected to it and sample allowed to flow into the sample tube. The glass stopper then is removed from the combustion chamber adapter, *8*, and the lamp assembly is inserted in its stead.

When burning is completed, excess sample is drained from the lamp back into the reservoir and the latter is filled to the reference mark *24*. The volume of sample required for this represents the volume consumed in the analysis. If gravimetric measurement of sample consumption is desired rather than volumetric, the reservoir is weighed before and after the burning.

The absorber solution and washings then are drained into the receiving flask *3* and titrated to methyl orange endpoint with 0.0624 *N* HCl. The percent sulfur present in the sample is calculated in the usual manner.

ITS CONTROL

Five distinct points of control are provided in this method and equipment:

1—Selection of the proper burner as dictated by the nature of the sample and previously discussed under "Operation," above.

2—Proper positioning of the tip of wick tube *15* in the flame cooling coil *11* to produce a clean, non-smoking flame.

3—Obtaining the proper level of sample in tube *16*. For gasoline samples, the level may be lowered as necessary, perhaps until it barely covers the lower end of the wick while, for the heavier distillates, it may be necessary to raise the sample level above the level of the flame. This sample level adjustment is accomplished by lowering or raising the position of the sample reservoir.

4—Determination of the optimum pressure differential to be held within combustion chamber *7*, using the indication of manostat *31*. For most samples—indeed during most of the combustion period—it is desirable to maintain a zero differential. However, during the initial phase of the combustion of many volatile samples, when the flame tends to burn too high despite the application of the three preceding control steps, it still may be brought under control by opening atmosphere control valve *30* until the pressure existing within the combustion chamber again brings the flame under control.

5—Varying (with discretion) the carbon dioxide-oxygen ratio in the artificial atmosphere to obtain optimum flame characteristics during combustion. It is this latter feature, rather than any set of empirical standards, which is used as a criterion for the conditions governing the combustion.

For instance, during the combustion of heavy distillates such as No. 2 fuel oil, particularly, much trouble is experienced with the formation of carbon "halos" on the tip of the wick tube if the oxygen content of the atmosphere is too high. This trouble is quickly remedied if the oxygen content is decreased in judiciously small steps until the halos no longer form.

Acknowledgments

The author wishes to thank the officials of Skelly Oil Co. for extending their permission for the presentation of this paper. He wishes to acknowledge with gratitude the aid and encouragement given by J. F. Wood in the development of this apparatus, and wishes to thank C. M. Briggs, R. O. Baird and G. E. Harris for making the original drawings and photograph.

This material was originally presented as a paper before the ACS Regional Conclave, New Orleans, Dec. 10, 1953, as "An Apparatus for the Determination of Sulfur in Petroleum Products by the Lamp Method."

References

(1) ASTM Standards on Petroleum Products and Lubricants, 1953 edition.
(2) ASTM Technical Committee H on Light Hydrocarbons. Communication No. A1-40-53.
(3) Edgar, Graham and Calingaert, George, "Determination of Sulfur in Gasoline." *Ind. Eng. Chem., Anal. Ed.*, 2, 104-106.

Let this panel of petroleum processing technologists, through the medium of a recorder, bring you . . .

TECHNICAL TIPS ON

Operations and Maintenance

CONCLUDING the series of questions and answers representing an interchange of practical experience and know-how, this month's "Technical Tips" will cover such diverse topics as alkylation, catalytic reforming, treating, and maintenance.

As stated in the opening article in this series in the April issue (pp. 529-533), the information herein was recorded during a session at the October meeting of the Western Petroleum Refiners' Ass'n. at El Dorado, Ark. A panel of nine technologists, representing broad experience in the industry provided answers to many questions Moderator of the panel was E. A. Heike, chief engineer, Premier Petroleum Co., Ft. Worth, Texas.

A refining group in the panel included: N. K. Anderson, director, research and development dept., Deep Rock Oil Corp., Cushing, Okla.; W. M. Carney, refinery superintendent, Lion Oil Co., El Dorado, Ark.; A. D. Fischbeck, manager, Perco Div., Phillips Petroleum Co., Bartlesville, Okla.; and H. K. Wheeler, ass't. manager, technical dept., Pan-Am Southern Corp., El Dorado, Ark.

An engineering group included: D. B. Ardern, Houdry Process Corp., Philadelphia, Penna.; C. O. Brown, American Cyanamid Co., Chicago, Ill.; Davis C. Read, Universal Oil Products Co., Des Plaines, Ill.; and E. C. Tinsley, Mexico Refractories Co., Mexico, Mo.

Subject covered first in this month's questions and answers is alkylation:

What has been the experience with regeneration of hydrofluoric acid: a) acid concentration and water content, b) volume of acid lost in constant boiling mixture, and c) how to remove water.

Fischbeck: We have operated HF alkylation units since 1942. During this time some experience has been gained bearing on this question. Acid-soluble oils and water are successfully removed by fractionation. An important factor in this operation lies in strict temperature control, whereby the total feed is vaporized at optimum pressure conditions. The pressures explored range from 25 to 150 psi.

It is important to keep the circulating acid at about 90% strength—in the range of 89 to 91%—with the water ranging from 0.5 to 1.5%. Losses of HF are accounted for as follows: 20% in the relief neutralizing system, 30% in the defluorinating chambers, and about 50% in the acid-soluble oils.

Water and acid-soluble oils are removed in the re-run column. The oils are separated, washed with water, settled in a water separator, neutralized with soda ash and yielded to storage.

There are chances of running into an emulsion problem but, by using a dilute soda ash solution not stronger than 5%, the difficulty is minimized. Temperature conditions in the re-run column will be about 420° F. on the bottom, feed temperature of about 290° F., top temperature around 240 to 250° F., and an operating pressure of 120 psi.

For every pound of water removed in the acid re-running system, a pound or more of acid is lost. Re-run unit operation requires very strict control. Iso-butane is used for stripping as well as reflux to the tower and both are precisely controlled.

Some corrosion occurs in the re-run system, especially in the upper section of the stripper. This can be alleviated by lining the upper section with monel. That is about the only alloy we have in our HF units, except for valve and pump parts. The units are constructed of carbon steel.

HF alkylation units in many instances can be justified on the basis of producing motor fuel. The one at Borger was built for about 1800 b/d. Last month we averaged over 7000 b/d of light alkylate. Since 1942 there hasn't been much time available to install all the improvements desired on

the Borger unit. If one evaluates one day's run time against improved operating efficiency, it is rather difficult to justify the down-time. The unit is down approximately five days every two years on scheduled turnarounds.

From floor: You mentioned a turnaround time of five days. How much equipment is involved—how many towers, and so on?

Fischbeck: The complete HF alkylation unit considered on a battery limit basis.

Is that on-stream to on-stream time?

Fischbeck: Yes.

How many man-hours does that involve?

Fischbeck: I'm sorry, I do not have the answer to your question.

Do you have a reboiler in the bottom of that acid re-run tower?

Fischbeck: Yes.

Has anyone attempted chemically to clean fractionating towers of HF alkylation units?

Read: I believe inhibited hydrochloric acid has been used.

Fischbeck: If an HF unit is properly operated, there will be very little if anything to clean from fractionating columns.

Read: All I know is that there has been some experience in using inhibited HCl for this. I do not know the details.

Has anyone an instrument for measuring spent alkylation acid concentration and control which they believe to be as good or better than that reported in the literature by Tide Water of California?

From floor: We don't have one. We use a gravimetric method of determination of spent acid for control. Every three or four hours a potentiometric titration is run as a check.

Carney: Is anyone having any trouble with fouling of the reboiler on the alkylation re-run tower or the deisobutanizer reboiler? If so, what is your cure? We have run into this and have been told that some people are using amine solution as an inhibitor, and some others have been using spent caustic containing acid oils for an inhibitor. What is the experience of this group?

From floor: We use "Kontol" to control corrosion, but fouling is another thing and I don't know that we have any solution for that. We have had some success controlling corrosion in fractionating towers in sulfuric acid alkylation plants with "Kontol" and controlling pH with MEA (monoethanolamine—Ed.).

Heike *(to Carney)*: Are those reboilers kettle-type? They are not once-through?

Carney: Tubular type.

Heike: We ran into that during the war. We converted numerous kettle types into once-through reboilers in order to avoid this, by increasing the velocity and reducing residence time to minimize polymerization of heavy alkylate.

From floor: You will get into trouble with aviation gasoline, too; if you are using caustic as an inhibitor.

Carney: That's another problem. The alkylate is blended into aviation gasoline, so whatever additive which might be used as an inhibitor would have to be approved by the military before it could be used, anyway. I have discussed this with the "Kontol" people —of course you can use it for corrosion control—but it does no good in preventing fouling of the reboiler.

TREATING

What has been the experience with treating C_3's contaminated with HF acid for sale as liquefied petroleum gases?

Fischbeck: We wash LPG from HF units with 5% caustic.

Take the propane off the top of the depropanizer and caustic wash it, then dump the caustic?

Fischbeck: After stripping for HF removal the LPG is caustic washed.

HF strip, then caustic wash? With KOH?

Fischbeck: We use sodium hydroxide.

Are there any advantages in treating kerosine first with acid and then following with Doctor solution and clay treating as compared with Doctor treating first?

Read: There is no specific answer to this question. There are advantages to acid treating rather than Doctor treating first with some stocks, such as those having such a high mercaptan content that Doctor treating is impossible without some mercaptan reduction. Of course, if phenols are present, there are other chemical reactions taking place which prevent making any hard and fast rule about the sequence of those steps.

Are there any LPG finishing facilities which will insure a sweet, non-corrosive product?

Fischbeck: Just a good two-stage caustic washing system to remove H_2S and mercaptans.

At what gasoline mercaptan level should installing mercaptan *extraction* facilities be considered, to reduce TEL requirements?

Read: No definite answer to this question would be generally applicable, since the TEL requirements are affected by so many different variables. It is a function not only of mercaptan content but the relative amounts of mercaptan and non-mercaptan sulfur present. This question brings in the whole refinery octane barrel picture and the economics of various other methods of raising octane number.

It might be said that Unisol treating to extract mercaptans can show a reasonable payout time under certain conditions on thermally cracked gasoline when the mercaptan sulfur content is as low as 0.02%. This would be a case, though, where the TEL savings would pay for the additional investment for the Unisol unit over the cost of a conventional sweetening unit and not upon replacing an existing treater with a Unisol unit. I think each case should be studied separately to know exactly where to recommend installing such facilities.

What laboratory control might be used with a continuous Doctor treatment system to determine when to dump the Doctor? We have a normal lead content for the Doctor solution. When this is used in a continuous treat system, the lead decreases very rapidly and the sulfur required to complete the reaction goes up. There is no specific chemical check that we have been able to correlate entirely. Does anyone have any experience on this?

McMahan*: The most feasible con-

* Universal Oil Products Co., Des Plaines, Ill.

trol is by running total inert sulfur on a Doctor solution which contains more than 100 lbs./bbl. of the used sulfur, although I have seen Doctor solutions of as high as 150 lbs. of sulfur capable of being regenerated.

We normally run PbO, caustic content, and total inert sulfur. Of course every Doctor treater favors his own rule of thumb—I happen to like 40 to 50 lbs. of caustic. We hold 4 to 8 lbs./bbl. of PbO and total inert sulfur less than 100 lbs., with Baume gravity as low as you can get it.

CAT REFORMING

How should a refiner determine the boiling range stock to be catalytically reformed when he is evaluating catalytic reforming?

Ardern: Houdry has published a couple of papers in which an evaluation of charging stock has been made. It is quite involved. We have looked at it from the standpoint of the overall finished blend, starting with a full-range motor naphtha, reforming part of the naphtha, and then blending back again with the lighter portion (which did not go through the reformer) in order to come up with a finished blend of total naphtha equivalent to the original naphtha we started with.

The question immediately arises as to what octane is required in this finished blend. That has been proven very important in dictating what quantity or portion of straight run material should be reformed.

We have published information in which East Texas naphtha was evaluated in this way. We have shown there that, at a fixed octane level, the economics favored reforming the narrower, heavy-boiling cut provided the octane level was of the order of 86 oct. The 300 to 400 naphtha could be reformed and blended back with the balance of the straight-run naphtha boiling below 300°F to make 86 oct. On the other hand, if the refiner wanted a full blend of 92 oct., then it was necessary to reform the full cut from 180 to 400° F.

Arabian crude has been similarly studied. This again showed it was a question of the octane level which it was necessary to achieve in the total blend. This must be worked out in terms of the rest of the refinery facilities—catalytic cracking, thermal cracking, etc.—which make the final refinery gasoline.

This is an involved problem which must be evaluated in terms of each individual plant. As a general rule, our studies say that the economics are in favor of reforming the narrowest cut which will finally permit making the desired refinery blend of gasoline.

Read: We agree with that so far as motor fuel operation is concerned. There is no general advantage in charging a pentanes and lighter cut to a Platforming unit. In some cases it is not even necessary to charge the whole C_5 to 400 cut to get the desired overall refinery octane barrels. In these cases the 200 to 400° or even the 250 to 400° or 300 to 400° cuts would be charged.

Some very small Platformers have been designed initially to charge a full-boiling 400° end-point gasoline, including all the pentanes and lighter, where investment cost is a big problem. The idea in mind is that the necessary fractionating column ahead of the unit might be added later to increase capacity.

For producing aromatics—benzene, toluene and xylenes—a rather select cut must be charged to the Platforming reactor, ranging from 150 to about 270°F to include all of those naphthenes which make these three aromatics. Of the 70 Platformers which have been licensed so far, there are about ten making aromatics. The other 60 are making motor fuel, or will when completed.

What type of burners would—or could—be used for burning off-gas from the reactor product separator which is rich in hydrogen—around 75 to 80%, low Btu value.

Heike: At our plant, we add the stabilizer gas to it, which has sufficient propane to bring the total Btu up to around 1000. It then goes to the gas mixing valve, together with natural gas, and we burn the final mixture.

Fischbeck: I observed an experimental burner in operation not long ago which the makers claim will burn 85% hydrogen mixed with 15% propane or butane. The burner was equipped with a metal tip which was maintained at a high temperature. Once in operation the burner appeared to perform well.

Heike: Some people have considered using that gas as fuel for gas engines. This is another problem which is being worked on.

MAINTENANCE

Has anyone successfully removed lime deposits from coking furnace tubes by chemical agents?

Fischbeck: We decoke by burning. About 60-80% of deposits are removed by the turbulent action of the coke that has been removed. We use high volumes of steam and air.

Do you erode the tubes?

Fischbeck: Unusual erosion is rarely experienced. Tubes downstream from the burning zone contain coke which is eroded by loose coke being removed. Upstream from the burning zone, only steam and air are passing through the tubes.

From floor: We use a two-stage operation; spalling first with high velocity steam through the tubes. We remove probably 60% of the deposits adhering on tube stills, where there is considerable salt in the crude in the spalling operation, following which we go into burning. We have yet had no visual inspection experience revealing fusion of salt deposits; they have apparently been removed during the spalling operation. We have a red deposit there, occasionally, which washes out.

Has any chemical been used successfully to clean boiler superheater tubes while boilers are in operation?

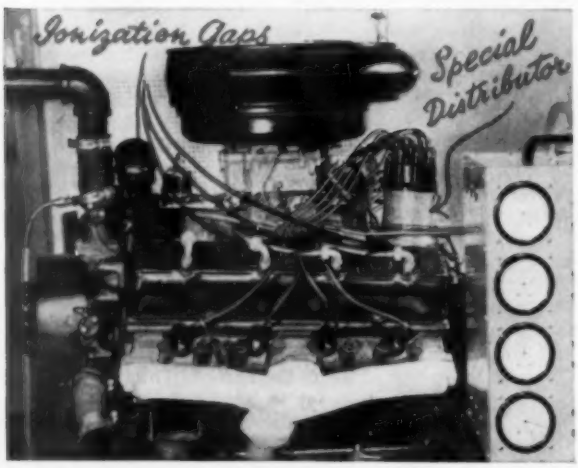
Read: If this question has reference to slag on the outside of tubes, which may be formed by such metals as vanadium and nickel in the fuel, there is quite a research project going on involving the injection of kaolin and dolomite, I believe, in the fuel to make it easier to get the slag off the outside of the tubes.

What is the best method for removing oil from condensate used as boiler feed water?

From floor: Our utilities supervisor has stated as his experience in another plant that they had been using steam to heat raw oil tanks. This amounted to about 40,000 lbs./hr. of condensate—quite a sizable amount of material.

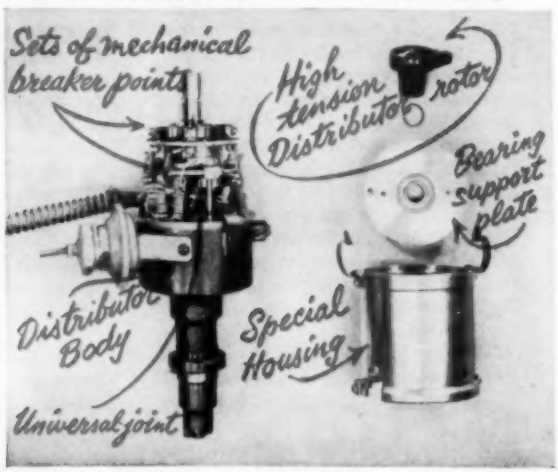
They used what they called "Turkish towel filters"; if you can visualize a towel about 3 ft. wide and, I guess, about 30 or 40 yds. long, wrapped on a drum and used as a filter. The oily condensate was pumped into a tank and suction was taken on the drum. Periodically it was backwashed with steam to clean it. This effectively reduced losses of condensate. His opinion, however, was that it is better to put the condensate down a ditch and forget it. (Laughter.)

Preignition counter developed at Ethyl laboratories makes each cylinder tell its own story on preignition. It accurately records, for the first time, both audible and inaudible preignition in a passenger-car engine.



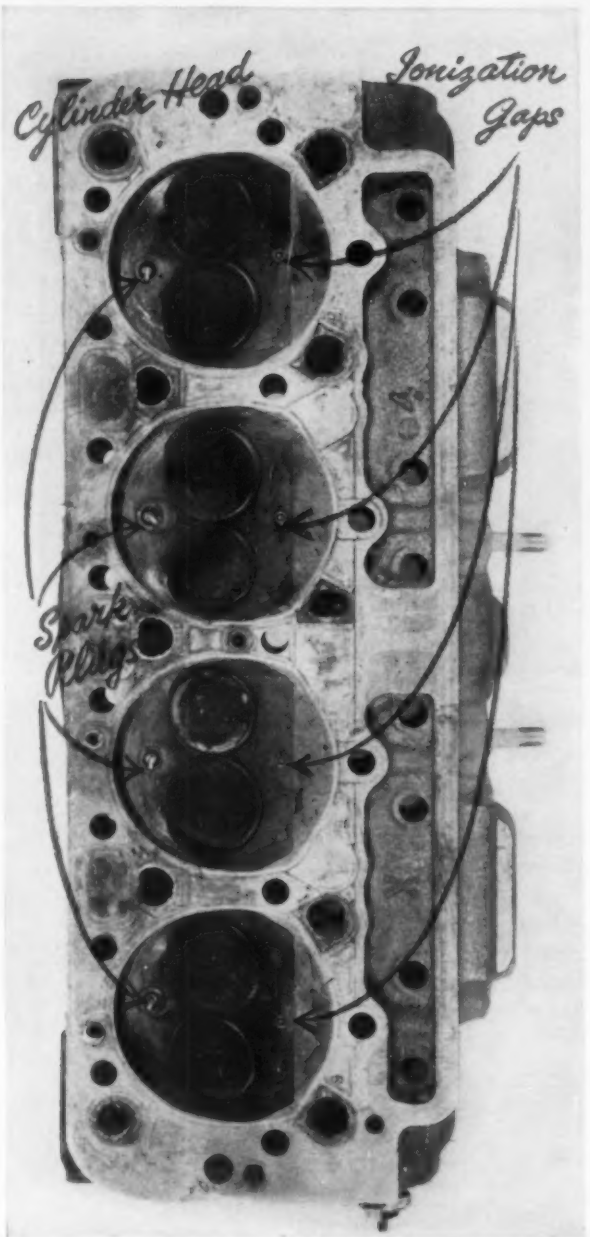
Test setup for the ionization-gap technique of recording preignition in a multicylinder engine.

Timing mechanism tells gaps to count only when flame comes from preignition, and not from spark plugs.



ETHYL RESEARCH FIRES BACK AT PREIGNITION

New Ethyl-developed test instrument pinpoints flame frontiers



Multicylinder head shows how the ionization gaps are mounted in the test engine to detect both audible and inaudible preignition.

FOR YEARS, the best minds in the petroleum and automotive industries have sought to find out what leads to preignition—the phenomenon that occurs when the gasoline-air charge is ignited in advance of the spark. Is the fuel at fault? Is the oil at fault? Is it the design of the chamber and its parts? Or is it a combination of all of them?

Ethyl Research Laboratories have been working on the problem of preignition for more than ten years. Recently they developed a new test instrument which for the first time enables researchers to find out when preignition—both audible and *inaudible*—occurs in a passenger-car engine.

First they mounted a series of ionization gaps—tiny spark plugs—in the head of a multicylinder test engine. Then they loaded them with a charge of electricity—but not enough to make a spark jump. When the ionized gas of a flame reaches one of these little plugs, current will flow across the gap. These "leaks" are recorded on a counter. So it is now possible for the first time to get an accurate count of each flame caused by preignition in a multicylinder engine.

By correlating the results of this test work with other Ethyl research, new insight into the nature of combustion is being achieved.

ETHYL CORPORATION
Research Laboratories
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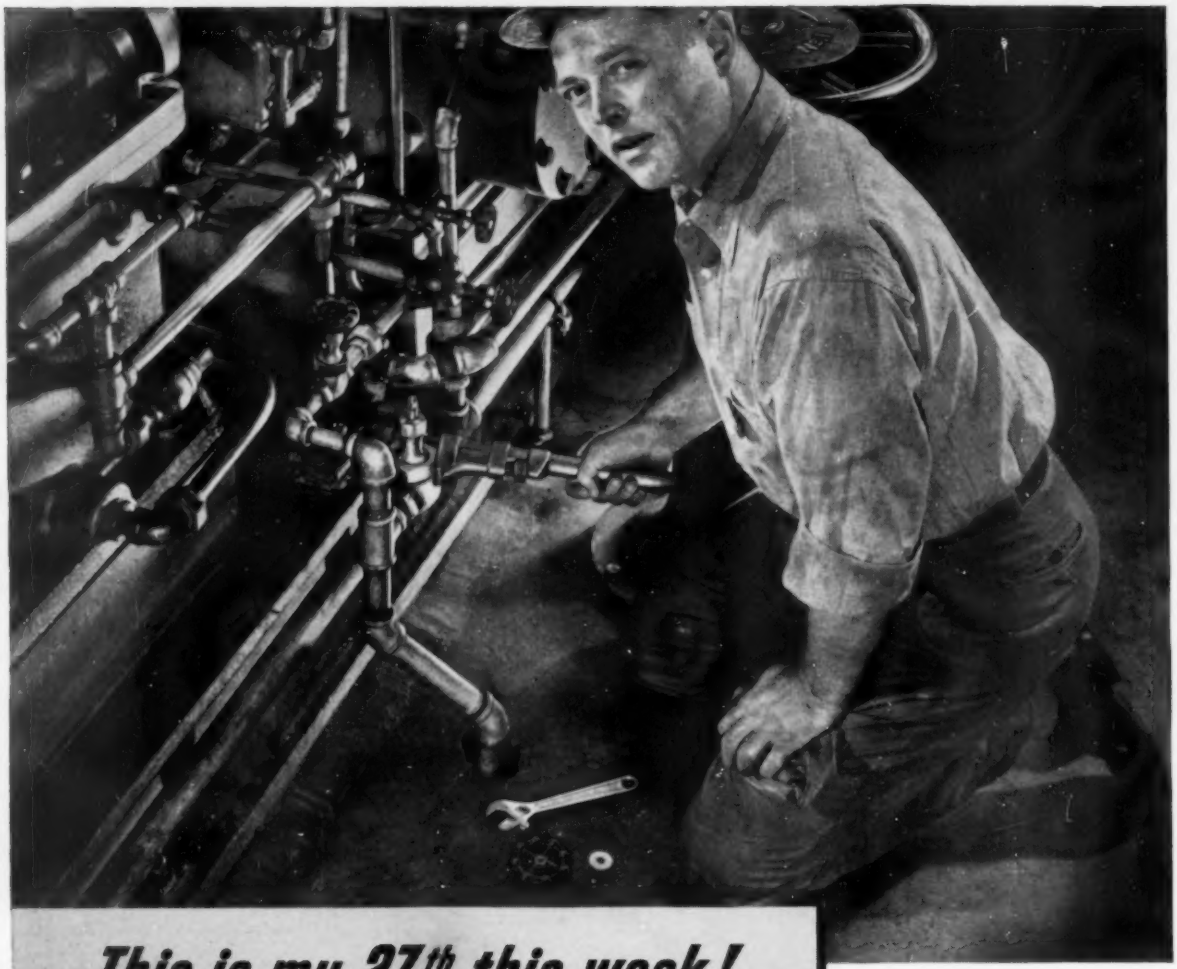

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PETROLEUM PROCESSING

JULY 1954

Petrochemical Processing Section

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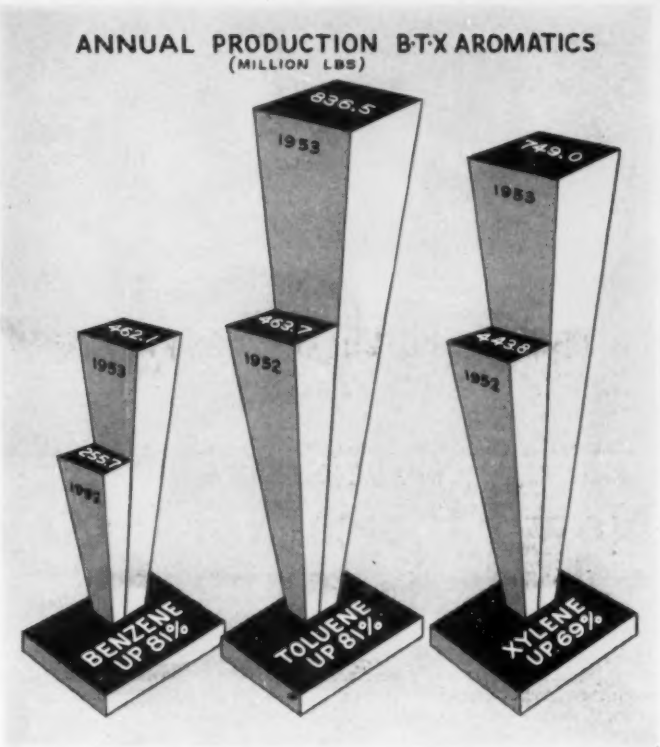

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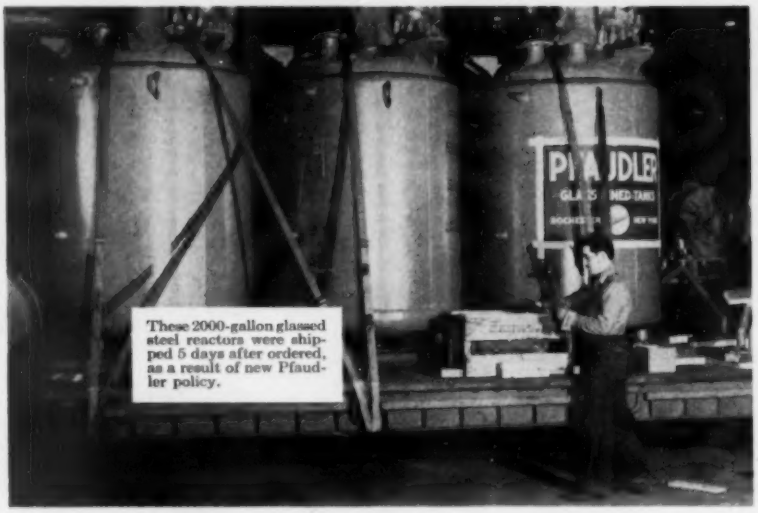

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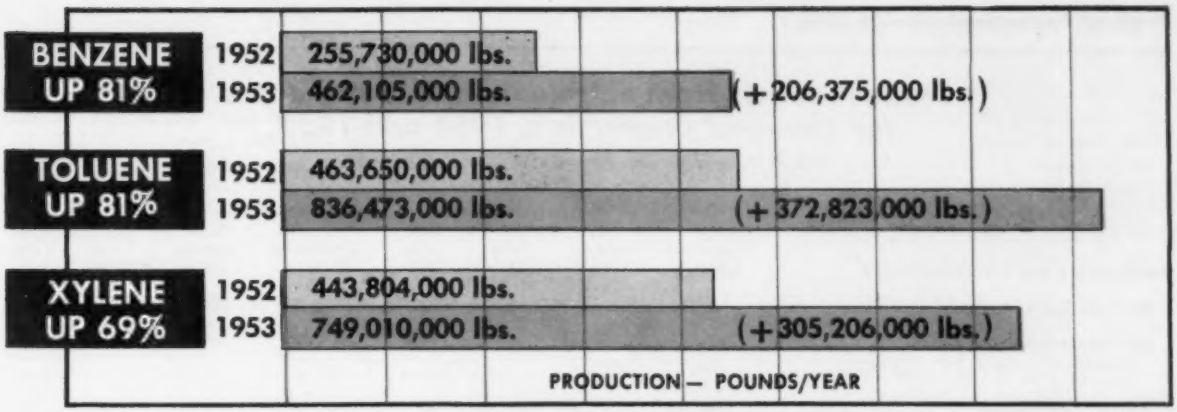


OUTPUT OF B-T-X AROMATICS from petroleum went up 76% last year to pace the growth of . . .

Primary Petrochemicals—Up 38%

PACED by the popular B-T-X aromatics—benzene, toluene, xylene—output of primary petrochemicals jumped 38% last year to over 10 billion pounds. Production in 1953 was 10,819,244,000 lbs., an increase of 2,952,340,000 lbs. over 1952's production of 7,866,904,000 lbs.

The B-T-X aromatics, although they account for only about a fifth of all the primary petrochemicals, showed the biggest gain. Output of these three chemicals in 1952 totaled 2,047,588,000 lbs., an increase of 884,404,000 lbs. (76%) over the 1952 output of 1,163,184,000 lbs.

These figures are based on a preliminary report from the U. S. Tariff Commission on 1953 operations in synthetic organic chemicals. The Commission doesn't report petrochemicals as such. It does, however, as part of its annual report on Synthetic Organic Chemicals, compile data on "U. S. Production and Sales of Crude Products from Petroleum and Natural Gas for Chemical Conversion." This category includes two main groupings—(1) aromatics and naphthenes, and (2) aliphatic hydrocarbons. These are considered as comprising the primary petrochemicals—petroleum hydrocarbons which generally serve as raw materials for further processing into finished products.

Highlights of the 1953 report, tabulated and compared with 1952 operations by PETROLEUM PROCESSING's editors, are given below. The complete 1953 and 1952 reports appear on the next page. Study of the figures shows up three important trends which appear to be taking shape in the industry:

- The B-T-X aromatics are expanding at a faster clip than other primary petrochemicals.

Highlights of Primary Petrochemical Statistics—1953 vs. 1952

	Aromatics and Naphthenes	Aliphatic Hydrocarbons	TOTAL
PRODUCTION, lbs./yr.			
1953	2,499,014,000	8,320,230,000	10,819,244,000
1952	1,605,121,000	6,261,783,000	7,866,904,000
Change	+893,893,000	+2,058,447,000	+2,952,340,000
% change	56%	33%	38%
SALES, lbs./yr.			
1953	1,793,722,000	5,191,932,000	6,985,654,000
1952	1,280,261,000	3,451,300,000	4,731,561,000
Change	+513,461,000	+1,740,632,000	+2,254,093,000
% Change	40%	50%	48%
SALES, as a percentage of production			
1953	72%	62%	64%
1952	80%	55%	60%
VALUE OF SALES, $/yr.			
1953	72,979,000	226,000,000	298,979,000
1952	46,612,000	218,653,000	265,265,000
Change	+26,367,000	+7,347,000	+33,714,000
% change	55%	3%	13%
UNIT VALUE, $/lb.			
1953	$0.041	$0.044	$0.043
1952	0.036	0.063	0.056

Crude Products from Petroleum and Natural Gas for Chemical Conversion, 1953 and 1952

Source: U. S. Tariff Commission (1953 figures preliminary)

	1953				1952			
AROMATICS and NAPHTHENES[1]	**Production, 1,000 lbs.**	**Sales, Quantity, 1,000 lbs.**	**Sales, Value, $1,000**	**Unit Value, $/lb.**	**Production, 1,000 lbs.**	**Sales, Quantity, 1,000 lbs.**	**Sales, Value, $1,000**	**Unit Value, $/lb.**
Alkyl aromatics, distillates, solvents	403,168	398,043	9,095	.023	391,263	374,805	8,306	.022
Benzene (except motor grade), total[4]	462,105	301,051	20,790	.069	255,730	191,880	12,788	.067
Benzene, 1°	75,975	—	—	—	—	—	—	—
Benzene, 2°[2]	386,130	—	—	—	—	—	—	—
Cresylic acid, crude	10,780	6,246	320	.051	14,317	5,761	335	.058
Naphthenic acids, total	23,123	14,294	1,541	.108	19,319	13,585	1,545	.114
Acid No. 225-249	10,999	10,557	1,222	.116	9,792	—	—	—
All other	12,124	3,737	319	.085	9,527	—	—	—
Toluene, all grades, total[3]	836,473	658,195	26,862	.041	463,650	332,873	11,993	.036
Nitration grade, 1°	192,113	166,440	7,441	.045	—	—	—	—
Pure commercial grade, 2°	282,338	—	—	—	—	—	—	—
All other	362,022	—	—	—	—	—	—	—
Xylenes, mixed	749,010	402,213	13,637	.034	443,804	344,357	10,934	.032
All other[4]	14,355	13,680	734	.054	17,038	17,000	711	.042
TOTAL, aromatics and naphthenes	**2,499,014**	**1,793,722**	**72,979**	**.041**	**1,605,121**	**1,280,261**	**46,612**	**.036**
ALIPHATIC HYDROCARBONS								
C_2 Hydrocarbons, total	2,280,363	362,350	12,761	.035	2,012,674	248,126	11,180	.045
Ethane	144,623	108,450	720	.007	203,179	—	—	—
Ethylene[5]	2,135,740	253,900	12,041	.048	1,809,495	—	—	—
C_3 Hydrocarbons, total	2,439,041	1,715,575	18,652	.011	1,576,421	868,111	10,618	.012
Propane	1,216,984	1,043,742	10,952	.010	580,139	404,850	4,149	.010
Propylene, propane-propylene mixtures	1,222,057	671,833	7,700	.011	996,282	463,261	6,469	.014
C_4 Hydrocarbons, total[6]	3,079,571	2,780,070	182,374	.066	2,373,650	2,091,157	187,199	.089
1,3-Butadiene, grade for rubber, total[7]	1,152,197	1,135,292	136,235	.120	1,106,445	1,094,453	154,396	.141
Produced for Government account	1,051,468	—	—	—	1,023,006	—	—	—
Produced for private account	100,729	—	—	—	83,439	—	—	—
n-Butane	388,581	236,965	2,985	.013	37,856	20,265	252	.012
1-Butene and 2-Butene mixture[8]	906,732	882,803	26,714	.030	825,171	799,995	24,622	.031
Isobutane	97,625	92,926	1,413	.015	—	—	—	—
All other[9]	534,439	432,084	15,027	.035	404,178	176,444	7,929	.045
C_5 Hydrocarbons[10]	38,260	25,722	1,713	.066	15,401	6,755	751	.111
All other aliphatic hydrocarbons and derivatives, total	482,992	308,215	10,500	.034	283,637	237,151	8,905	.037
Di-isobutylene	23,157	—	—	—	25,325	11,959	773	.065
Dodecene (tetrapropylene)	176,926	125,100	4,685	.037	114,983	112,447	3,856	.034
Nonene (tripropylene)	60,986	4,828	217	.045	—	—	—	—
Hydrocarbons derivatives[11]	2,681	2,496	462	.185	1,920	1,880	308	.164
All other[12]	219,242	175,791	5,136	.029	141,409	110,865	3,968	.036
TOTAL, aliphatic hydrocarbons	**8,320,230**	**5,191,932**	**226,000**	**.044**	**6,261,783**	**3,451,300**	**218,653**	**.063**
GRAND TOTAL	**10,819,244**	**6,985,654**	**298,979**	**.043**	**7,866,904**	**4,731,561**	**265,265**	**.056**

(1) The chemical raw materials designated as aromatics are in some cases identical with those obtained from the distillation of coal tar. However, the statistics given in the above table relate only to such materials as are derived from petroleum and natural gas.
(2) Includes a small amount of 90% benzene.
(3) Includes data for toluene concentrate (aviation fuel component) on a 90% basis, as well as for pure commercial and solvent-grade toluene.
(4) Figures for 1953 include data for motor grade benzene, cyclopentane, dicyclopentadiene, petroleum phenols, sodium carbolate and phenate, and hydrocarbon polymers; figures for 1952 include data dicyclopentadiene, petroleum phenols, sodium carbolate and phenate, and hydrocarbon polymers.
(5) Includes a small amount of ethylene from coke-oven gas.
(6) Data for butane and butene blending stocks for motor fuels are excluded from these statistics. Statistics for previous years included such data.
(7) Sales value for 1953 partly estimated.
(8) The statistics represent the butene content of crude refinery gases from which butadiene is manufactured.
(9) Figures for 1953 include data for isobutene, 1-butene, 2-butene, butane-butylene, and butadiene-butene mixtures and concentrates; figures for 1952 include data for isobutane, isobutene, n-butene, and butadiene-butene mixtures and concentrates.
(10) Includes data for pentanes, pentenes, isoprene and mixtures.
(11) Includes data for di-tert-butyldisulfide, miscellaneous mercaptans, and mixed alkanesulfonic and aliphatic acids.
(12) Figures for 1953 include data for acetylene, hexanes, heptanes and heptenes, methane, octanes and octenes, polybutene, eicosane and hydrocarbon mixtures; figures for 1952 include data for hexanes, heptanes and heptenes, octane and octenes, nonene, polybutene, eicosane and hydrocarbon mixtures.

• A greater portion of the aromatics is becoming "captive"—is being used by the original producers for further processing rather than being offered for sale.

• The aliphatics as a group are dropping in value—perhaps indicating approaching saturation of some parts of the field.

Growth of the B-T-X aromatics can be attributed to the increased use by refiners of catalytic reforming processes. A survey by PETROLEUM PROCESSING last fall indicated that 66 such reformers were then in operation or under construction and expected to go on stream before the end of the year, with a total charge capacity of about 450,000 b/d.

Most of these units are operated to upgrade motor gasoline or produce aromatic concentrates for avgas blends. But an idea of the tremendous potential of B-T-X aromatics which can be produced from petroleum is seen when the 1953 output of 884,404,000 lbs. is converted to the refiner's more common unit of bbls./day. It comes to roughly 8,000 b/d.

Individually, each of the three aromatics showed strong growth, as indicated in the detailed figures. Benzene output rose from 255,730,000 lbs. in 1952 to 462,105,000 lbs. in 1953, a gain of 206,375,000 lbs. or 81%. Toluene jumped from 463,650,000 lbs. to 836,473,000 lbs., a gain of 372,823,000 lbs. or 81%. Xylene went up from 443,804,000 lbs. in 1952 to 749,010,000 lbs. in 1953, a gain of 305,206,000 lbs. or 69%.

Total output of aromatics and naphthenes as a group went up 56%—but only because of the increases in the B-T-X trio. If the output of these three chemicals is removed from the totals, the figure for the remaining aromatics and naphthenes shows only a very slight gain in 1953 over 1952—9,489,000 lbs., or about 2%.

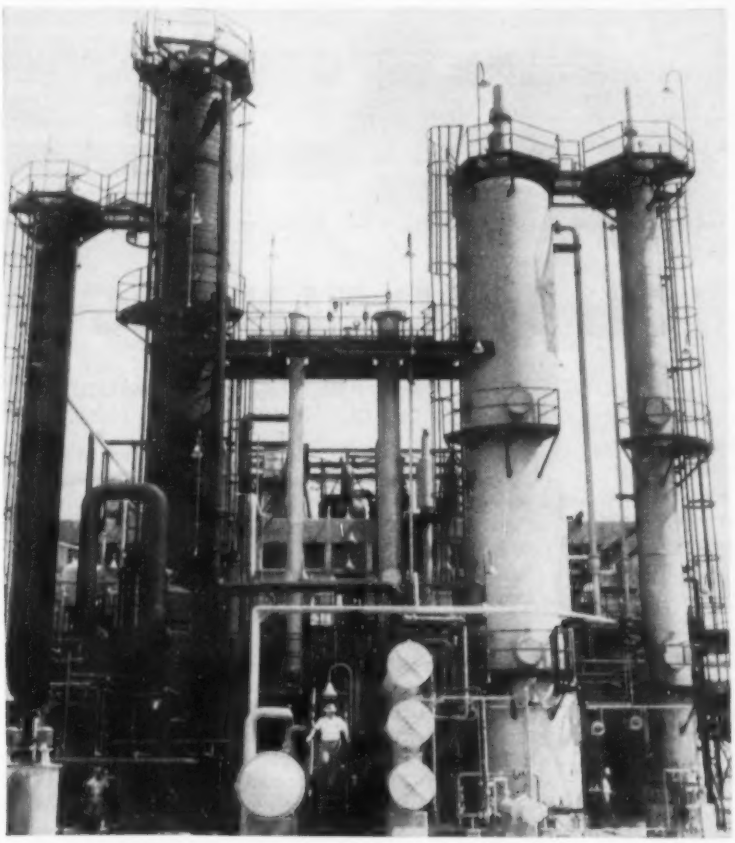
Aliphatics, on the other hand, showed a more even over-all growth. Output of this group of primary petrochemicals went from 6,261,783,000 lbs. in 1952 to 8,320,230 lbs. in 1953, an increase of 2,058,447 lbs., or 33%.

Increasing "captive" use of the aromatics for further processing by the original producer is evident from a study of the sales figures in the reports. In 1952, 80% of the aromatics and naphthenes produced were reported sold, but last year that figure dropped to 72%. It would appear, then, that only 20% of the aromatics and naphthenes produced in 1952 were further processed by the producer, but that 28% were so handled last year.

Aliphatics show an opposite trend. Of 1952 production, 55% was reported sold, but 62% of 1953 production shows up in the "sales" column, indicating that more of these primary petrochemicals are going to market.

Unit values of the aliphatics dropped from $0.063/lb. in 1952 to $0.044/lb. in 1953. The aromatics and naphthenes, on the other hand, went up from $0.036/lb. in 1952 to $0.041/lb. in 1953. Over-all for both groups, unit value went down from $0.056 in 1952 to $0.043/lb. in 1953.

One point to bear in mind in connection with these unit value figures is that they are weighted averages for products which vary widely in their individual unit values and in the quantities sold.



New Ethylene Oxide Plant Uses Direct Oxidation

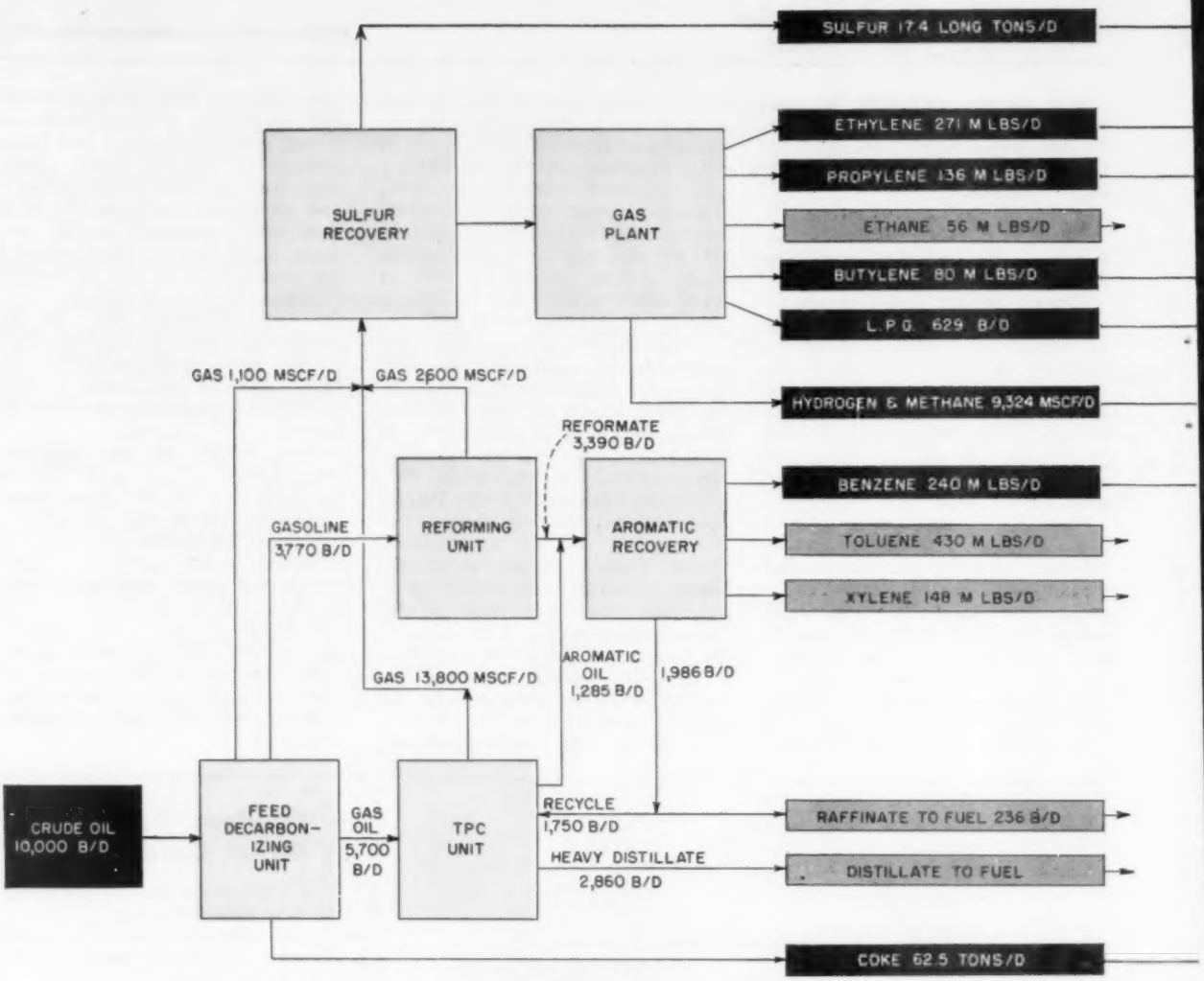
FIRST U.S. installation of a new direct oxidation process for making ethylene oxide has been put on stream by the Nitrogen Division of Allied Chemical & Dye Corp. at Orange, Texas.

Using a process designed and licensed by Scientific Design Co., the plant produces ethylene oxide by the direct oxidation (over a silver catalyst) of ethylene with air, thus eliminating the conventional chlorohydrination route—which uses chlorine as an indirect oxidant.

The new Allied plant further processes the ethylene oxide to ethylene glycol and diethylene glycol. The oxide is said to have an extremely high purity—with an aldehyde analysis in the order of only 0.01% to 0.04%. The resulting glycols are likewise of high purity—as evidenced by the report that a large quantity of them are going into synthetic fibers.

Ethylene for the new Allied plant is supplied by Gulf Oil Corp. through a 22-mi. pipe line from its ethylene plant at Pt. Arthur.

First commercial installation of the new direct oxidation process was put into operation last year in France by Naphtachimie et Cie. It cost in the neighborhood of $20,000,000 and had a design capacity of 17,000,000 lbs. of oxide per year. The Allied installation reportedly cost $5,000,000.



FANCY OR POSSIBLE FACT? Here's how an oil refinery might look if it were a "Chemofinery" and . . .

'CHEMOFINING' . . .

***BEFORE YOU READ** this article, you should know that it is a semi-serious treatment of a serious subject—the future role of petroleum in the increasingly complex technological society. The writers have embarked on a flight of fancy from present-day petrochemical thinking. They have put a new twist on prognostication and their article points to a foreseeable ultimate situation wherein the utilization of petroleum as a CHEMICAL source has superseded its utilization as an ENERGY source.*

By J. H. EPPARD and M. R. WINGARD
Blaw-Knox Co., Chemical Plants Div., Tulsa, Okla.

THIS discussion of the birth and infancy of the "Chemoprep Oil Company"* differs from the usual technical presentation in that we are dealing here with an idea, or a point of view, rather than extolling the virtues of some new process or presenting experimental data.

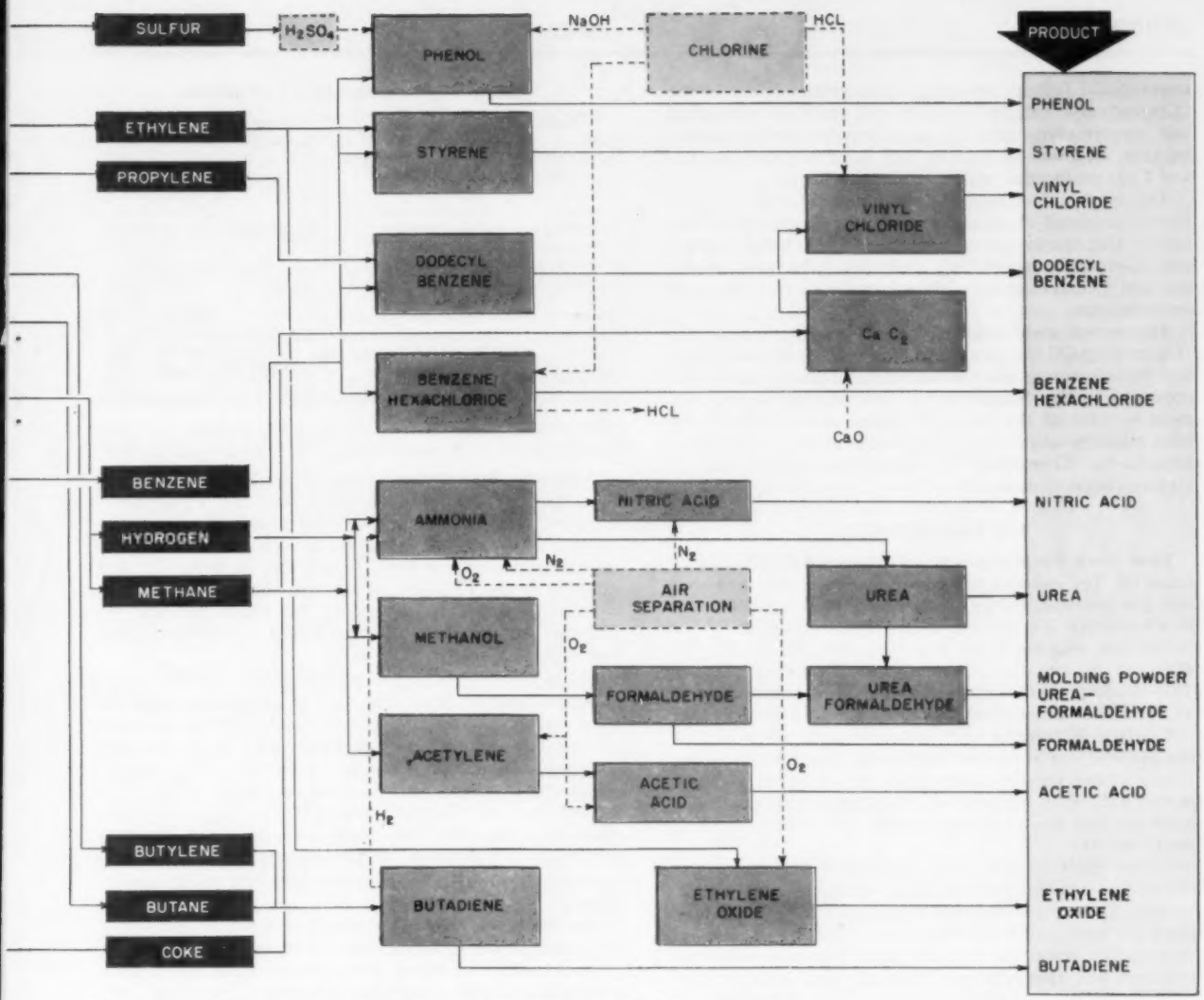
The history of our hypothetical "Chemoprep Oil Co." begins when a group of eastern financiers decided that the prospects for petrochemicals were bright enough to warrant their participation in the industry. The glowing accounts of a phenomenal growth and forecasts for a rosy future, such as appear in the business and financial press, were the prime factors influencing their decision.

In characteristic Wall Street fashion, our banker friends approached the problem from the angle of making "Chemopets" rather than petrochemicals. Being unfamiliar with conventional refinery practices, they considered crude oil as a raw material for chemical manufacture rather than in terms of ordinary refinery products.

Their first step in consummating the desire to enter the business consisted of investing in proven petroleum reserves which, fortunately for their purposes, turned out to be sour West Texas crude having the composition shown in Table 1.

After this, a preliminary survey was made of the type of products which could be realized from the various possible

* The name "Chemoprep" was coined by Mr. M. H. McMurrey, McMurrey Refining Co., Tyler, Texas.



HOW "CHEMOPETS" MIGHT BE MADE from product streams of the "Chemofinery"

Petroleum's Future?

operations and they were immediately faced with another decision. They found that a very large amount of their crude oil material could not be readily converted to petrochemicals without very elaborate processing.

The conventional methods of processing the crude oil produced only a small amount of raw materials for the manufacture of "Chemopets" but large quantities of gasoline and fuel oils.

These products, which were to them by-products (we know them as conventional refinery products such as gasoline, diesel oil, and fuel oil) presented a dilemma. They considered four possible schemes to dispose of these unwanted "by-products":

1—They could be pumped back into the ground.

2—They could be sold for fuel oil at the ridiculously low price of seven cents a gallon (in terms of chemical prices).

3—They could be further processed to make more chemical raw materials.

4—They could be used for fuel in processing.

It was decided that the fuel use would be preferred initially, with future provisions for further processing.

Consistent with previous actions, these wizards of finance set up their "Chemoprep Oil Company" operations based on the following process scheme:

The first distinct section we will term a "Chemofinery" inasmuch as this section of the project is designed to produce a maximum of chemical raw materials and minimum

Table 1—Analysis of Crude Oil for "Chemoprep Oil Co."

Sulfur, per cent		1.66
API gravity		35.0
Distillation:	**%**	**API Gr.**
Loss	1.9	—
Gasoline	33.6	59.5
Kerosine	9.3	42.1
Gas oil	13.7	32.2
Distillate	15.4	26.0
Bottoms	26.1	12.5

conventional refinery products. The essential pieces of the "Chemofinery" selected were a feed stock decarbonizing unit, catalytic reforming unit, a Thermofor pyrolitic cracking unit, an aromatic recovery unit, a sulfur recovery unit, and a gas purification and separation unit.

The fundamental basis for the design of this "Chemofinery" consisted of an unusual chemical engineering concept, in that energy was put into the crude to break it down into compounds approaching elemental carbon and hydrogen and then reassembling these into the desired chemical intermediates.

The second main section of the processing scheme for "Chemoprep Oil Co." consisted of a number of petrochemical manufacturing units which utilized the raw materials produced in the "Chemofinery." In addition to the two main sections of the plant mentioned above, a group of what might be termed "general service units" are also added to make the "Chemoprep" firm more or less independent of outside chemical materials.

THE CHEMOFINERY

Feed Stock Decarbonizing unit processed 10,000 b/d of crude oil. The material vaporized in this unit was separated into gas, gasoline, and distillate. The residue was converted to coke, which is a valuable chemical raw material.

The flow diagram shows how this and other units to be discussed fit into the "Chemofinery" processing scheme. This section of the plant represented approximately a $1,000,000 investment and produced 62.5 ton/day of coke.

Catalytic Reforming unit processed some 3770 b/d of the gasoline cut from the feed stock decarbonizing unit. Gasoline and recycle hydrogen were heated to approximately 975° F. in the presence of a high partial pressure of hydrogen and passed through reactors containing a platinum catalyst.

Under these conditions, a substantial portion of the charge was converted to aromatics—benzene, toluene, and xylenes. The net gas produced was sent to the gas recovery plant for purification and separation, and the condensate went to the aromatics recovery unit. The investment for this unit was approximately $700,000 and 3390 b/d of reformate were produced.

Thermofor Pyrolytic Cracking unit feed consisted of the gas oil stream from the decarbonizer (some 5,800 b/d) plus 1,750 b/d of recycle from the aromatics extraction unit.

This device might be termed a chemical engineering "sledge hammer" in that the feed stock was actually beat into pieces by rigorous cracking conditions producing a maximum of gas, light ends, aromatics, olefins, etc.

When the operation of this unit was explained to our banker friends, one of them commented that we might call this an engineering "sewer" in that everything one doesn't know what to do with goes into it and what comes out is not recognizable.

The main elements of this cracker were a heater and reactor with refractory pebbles circulated between the two. In this case, the pebbles acted as a heat transfer medium. The oil was charged to the reactor where it was contacted by hot pebbles for preheating and cracking. The pebbles recirculated from the bottom of the reactor to the heater where they were reheated by burning off coke and by the direct combustion of fuel gas or oil, and from which they flowed by gravity back to the reactor.

NOTE: A Thermofor pyrolytic cracking unit was used in this instance, although an equally feasible installation could have been based on a tubular cracking furnace.

This unit represented an investment of $1,750,000; sent 1,285 b/d of aromatic oil to the aromatic recovery system; sent 13,800 MSCF/day of gas to the gas plant; and produced 2,860 b/d of heavy distillate which was used for fuel.

Table 2—"Chemofinery" Products

Product	Source	Investment	Quantity
Coke	Feed Stock Decarbonizing	$1,000,000	62.5 ton/day
H_2 and Methane	Gas Recovery		318,000 lb/day
Ethane	Gas Recovery		56,000 lb/day
Ethylene	Gas Recovery		271,000 lb/day
Propylene	Gas Recovery	$3,800,000	136,000 lb/day
n-Butylene	Gas Recovery		56,000 lb/day
n-Butane	Gas Recovery		68,000 lb/day
iso-Butylene	Gas Recovery		24,000 lb/day
LPG	Gas Recovery		55,000 lb/day
Benzene	Aromatics Recovery		240,000 lb/day
Toluene	Aromatics Recovery	$1,500,000	430,000 lb/day
Xylenes	Aromatics Recovery		148,000 lb/day
Sulfur	Sulfur Recovery	$250,000	17 ton/day

Aromatics Recovery unit received as charge aromatic oil from the TPC unit plus reformate from the "Catformer." Benzene, toluene, and xylene were produced as separate streams by a solvent extraction process. A portion of a raffinate produced was used for fuel and the remainder was recycled to the TPC unit as outlined above. This raffinate contained the paraffins originally fed to the catalytic reforming unit which could be cracked to desired olefins and aromatics in the TPC unit.

Our investment here was approximately $1,500,000.

Sulfur Recovery Unit: The various gas streams from the coker, reformer, and TPC unit were subjected to an amine treatment where H_2S was removed. This H_2S was then converted to sulfur by burning a portion to SO_2, and reacting the SO_2 and H_2S to form elemental sulfur. The treated gas from this unit continued on to the gas recovery plant, and the sulfur recovered from the H_2S becomes one of our raw materials for the "Chemopet" plant.

This unit added approximately $250,000 to the investment.

Gas Recovery Plant: The sweetened gas from the sulfur unit entered a low temperature vapor recovery unit. The gas was cooled and several raw materials were separated by fractionation and absorption. Hydrogen, methane, and ethane were produced as gas streams. Liquid streams of ethylene, propylene, butadiene, butane, and also propane were produced.

This unit was the largest single portion of the "Chemofinery" and it represented an investment of $3,800,000.

All the afore-mentioned units made up the "Chemoprep" refinery and were related as shown in the flow diagram. Table 2 lists the various products of this "Chemofinery" along with investment costs for specific units. It is interesting to note that in the "Chemopet" portion of the project we are expressing quantities in terms of weight—pounds or tons—rather than in barrels. Note that investment figures are for the recovery units only. Complete plant investment figures are reported later, and the total for the "Chemofinery" is $9,000,000.

THE "CHEMOPET" DIVISION

The next major division of the project consisted of the various petrochemical (in our case "Chemopet" inasmuch as the chemical aspects of the project are dominant) units selected to process the raw materials coming from the "Chemofinery."

These units were selected to show the wide variety of possibilities rather than through economic and marketing considerations which would dictate any actual project. It should also be pointed out here that these are only a few

of the number which could have been selected. We will break down our discussion of this section of the project according to the raw materials coming from the "Chemofinery." The processing is illustrated in the accompanying schematic diagrams.

Methane and Hydrogen

Ammonia: Approximately one-half of the methane available from the gas plant (307,000 lb./day) was partially oxidized to synthesis gas. All the hydrogen available was added to this synthesis gas and ammonia produced. The synthesis gas was purified and the proper nitrogen-hydrogen ratio provided by scrubbing with liquid nitrogen in a nitrogen wash plant. The nitrogen was obtained from an air separation unit (one of our general service units). This air separation unit also provided tonnage oxygen for the partial oxidation reaction.

The nitrogen wash plant investment was approximately $900,000 while our ammonia synthesis plant which produced 92,000 lb./day cost us about $5,000,000.

Urea: One-half of the ammonia produced in the unit described above was reacted with carbon dioxide to produce 166,000 lb./day of urea. A small amount of the product urea (15,000 lb./day) was utilized in producing urea-formaldehyde resin and the remainder sold as one of the "Chemoprep Oil Company" products. This plant represented an investment of approximately $3,500,000.

Urea-Formaldehyde Resin: This unit produced molding powder in a batch autoclave type of installation. It utilized 7700 lb./day of formaldehyde in addition to the urea mentioned above. Total annual production of the resin was 8,000,000 lbs. in the unit costing $500,000. This is another "Chemoprep Oil Co." sales product.

Nitric Acid: The remaining 50% of the ammonia produced above was oxidized to nitric acid in a unit costing about $900,000. Daily production of 175 tons of nitric acid (based on 100%) was available as a salable product.

Methanol: An additional 25% of the methane from the gas recovery plant was partially oxidized to synthesis gas and used to produce synthetic methanol. Production of 14,600 lb./day by this classic process was attained for an investment of $4,000,000.

Formaldehyde: The methanol produced above was partially oxidized to 65 ton/day of formaldehyde for a $500,000 investment. A portion went to the urea-formaldehyde resin unit already mentioned, and the remainder was another sales product of our "Chemoprep Oil Co."

Acetylene: The remaining 25% of the methane from the gas recovery plant was partially oxidized to 25 ton/day of acetylene in a unit costing $2,200,000.

Acetic Acid: All of the acetylene produced in the unit above was converted to 55 ton/day of glacial acetic acid in a $1,000,000 plant.

Benzene

Dodecyl Benzene: In this "Chemopet" unit, all the propylene available from the gas recovery plant plus 58,100 lb./day of benzene from the aromatics recovery unit were reacted to produce 176,000 lb./day of dodecyl benzene, a synthetic detergent intermediate. The reaction was carried out in two steps in which the propylene was first polymerized to the tetramer and then used to alkylate the benzene. The investment for this unit is approximately $1,250,000. This is another "Chemoprep Oil Co." salable product.

Benzene Hexachloride: 5,800 lb./day of the benzene from our aromatics recovery unit were converted to 6,600,000 lb./year of benzene hexachloride in a plant costing $250,000. A batch photocatalyzed chlorination was carried out using chlorine from another of our general service units to be described later. The benzene hexachloride produced is sold by the "Chemoprep Oil Co."

Phenol: In a classic sulfonation process, 188,000 lb./day of the benzene from our aromatics recovery unit were converted to 71,000,000 lb./year of phenol plus 304,000 lb./day of by-product sodium sulphite. The sulfonated benzene was neutralized and then fused with caustic soda obtained from a general service unit in a plant costing $4,500,000. The sulfuric acid was obtained from another of our general service units. Both the phenol and the by-product sodium sulphite are sales products.

Styrene was produced in a $3,000,000 unit from 46,600 lb./day of benzene from the aromatics recovery unit plus 15,500 lb./day of ethylene from our gas recovery plant. 19,000,000 lb./year of styrene monomer was produced by the dehydrogenation of ethyl benzene in turn produced from the ethylene and benzene.

Ethylene and Ethane

Ethylene: All the available ethane was cracked in a $600,000 tube cracking installation to produce 42,000 lb./day of ethylene which was recycled to the gas recovery plant for purification.

Ethylene Oxide: All the remaining available ethylene (after the styrene production requirement was fulfilled) was oxidized in a $10,000,000 ethylene oxide plant to produce 350,000 lb./day of salable product, ethylene oxide.

Butylene and n-Butane

Butadiene: 56,000 lb./day of n-butylene and 68,000 lb./day of n-butane were converted to 36,600,000 lb./year of butadiene by catalytic dehydrogenation in a unit representing an investment of about $6,000,000.

Coke

Calcium Carbide: The 125,000 lb./day of coke produced in the feed stock decarbonizing unit was used to produce 216,000 lb./day of calcium carbide in a crucible electric arc melt reaction with lime. This unit cost approximately $1,700,000.

Vinyl Chloride: The calcium carbide produced in the unit described above was reacted with water to produce acetylene, which in turn combined with anhydrous HCl from a general service unit to produce vinyl chloride monomer. This $7,000,000 unit turned out 68,000,000 lb./year of the purified and stabilized monomer for sale.

GENERAL SERVICE PLANTS

Chlorine: To further the aim of making our "Chemoprep Oil Co." fairly independent of outside services, we spent approximately $5,400,000 to produce chlorine, hydrochloric acid, and solid caustic soda from brine wells located at the plant site. 150,000 lb./day of chlorine was produced, which was used directly for benzene hexachloride and to make HCl used in vinyl chloride. 171,000 lb./day of caustic for phenol production were made in this mercury cell type chlorine plant.

Sulfuric Acid: 120 ton/day of sulfuric acid (basis 100%) were produced in a $600,000 unit using 17.4 ton/day of sulfur from our sulfur recovery unit and 22 ton/day of purchased outside sulfur. This sulfuric acid was utilized chiefly in phenol production although some was used in

Table 3—Products and Income of "Chemoprep Oil Co."

Product	Quantity Lb/year	Annual Return*
Acetic Acid	36,000,000	$3,770,000
Benzene Hexachloride	6,600,000	6,600,000
Butadiene	36,600,000	8,050,000
Dodecyl Benzene	58,200,000	7,150,000
Ethylene Oxide	116,000,000	15,700,000
Formaldehyde	17,500,000	735,000
iso-Butylene	7,900,000	60,000
Nitric Acid	115,000,000	5,150,000
Phenol	71,000,000	11,400,000
Sodium Sulfite	100,000,000	3,000,000
Styrene	19,000,000	4,000,000
Toluene	129,000,000	6,050,000
Urea	49,800,000	3,000,000
Urea-Formaldehyde	8,000,000	2,640,000
Vinyl Chloride	68,000,000	9,000,000
Xylenes	49,000,000	2,300,000
Total		$88,605,000

* Calender year. Note: unit prices as of June 1, 1954 market quotations.

Table 4—Economic Analysis of "Chemoprep Oil Co."

Income (annual)	$88,600,000
Investment (including offsites)*	73,950,000
Operating Costs:	
Total for Units	14,160,000
Crude oil charge (10,000 b/d)	8,250,000
Purchased additional utilities	630,000
Sales, overhead, research & development	9,000,000
	32,040,000
Fixed Charges:	
10% Write-off	7,400,000
Insurance	750,000
Property taxes	750,000
General area maintenance**	750,000
	9,650,000
Net before Income taxes:	
Net profit per year	46,900,000
Project payout (years)	1.6
Annual return on investment	63%
Net after Income taxes (assume 52% on net):	
Net profit per year	22,500,000
Project payout (years)	3.3
Annual return on investment	30%

* Generally, offsite facilities are not included except when conveniently part of process unit.

** Unit maintenance charges are included in operating costs for each unit.

chlorine drying and for other general purpose processing requirements.

Air Separation Plant: We installed a 200 ton/day, $1,000,000, tonnage oxygen-nitrogen unit which served in the ethylene oxide, ammonia, and synthetic methanol units. This unit could have been increased in size to 500 ton/day if we had chosen to utilize the oxygen separated therein in the production of nitric acid, acetic acid, acetylene, and formaldehyde as well. This would have reduced the investment in the process units involved.

FUTURE POSSIBILITIES

In general, the "Chemoprep Oil Co." Planning Committee has left many openings for future expansion. This could come about by increasing the "Chemofinery" capacity, producing more of the things already outlined, and also by additional facilities further processing those chemicals already produced.

Benzene could be used to produce aniline, insecticides, and maleic anhydride. Toluene could be further processed, instead of sold directly as now planned, to produce vinyl toluene, TNT, or cresol; and xylenes could be separated and phthalic anhydride for alkyd resins could be produced as well as the phthalic isomers for synthetic fiber.

The high unsaturates now used as fuel could be separated and through the Oxyl process be converted to alcohols, aldehydes, ketones, and acids. Instead of selling isobutylene, "Chemoprep" could convert it to butyl rubber, butyl alcohol, or methyl ethyl ketone. A portion of the butylene could be converted to polybutylenes. Propylene could be processed to glycols, alcohol, and cumene which in turn could lead to phenol and acetone.

There are a great many possibilities for the ethylene such as ethyl alcohol, acrylonitrile, ethyl chloride, ethylene dichloride, vinyl chloride, and polyethylene. The ethylene oxide could be carried on to glycol and ethanolamines.

ECONOMICS

As pointed out before, no particular effort was made to select the process for our fantasy based on economic and marketing considerations. However, we find that our banker friends made out fairly well. It is again emphasized that markets and other considerations would dictate an actual case and that the processing scheme presented was selected primarily to show the wide variety of possibilities. Table 3 shows the list of final products marketed and the annual income derived therefrom. Table 4 gives a summary of the economics involved for the entire project.

It is interesting to note that the "Chemopet" units completely overshadowed the refining end of our project. Less than 15% of the total investment was in the "Chemofinery." Operating costs for the "Chemofinery" were approximately only 15% of the total or less than $2,000,000/year. The number of units involved and the size of these units was much greater for the "Chemopet" Division than for the "Chemofinery." Also, the "Chemofinery" was a minor portion of the entire project, although we have merely touched on "Chemopet" possibilities.

Meet the Authors

Mr. Wingard

John H. Eppard, senior process engineer for Blaw-Knox Co., Chemical Plants Div., Tulsa, has been in the petroleum field since graduation from Kansas State College in 1940 with a B.S. in chemical engineering.

He was with Sinclair Refining Co., Houston, until 1942; a process engineer with Phillips Petroleum Co. at Kansas City and at Okmulgee until 1947; and senior process engineer for Stanolind Oil & Gas Co. research dept. until joining Blaw-Knox in 1952. (No photo available). Mr. Eppard is married and lives in Tulsa with his wife and five children, "all girls."

M. R. Wingard, western sales engineer for Blaw-Knox, has been with the company since 1945, in research, in process design, in plant start-up and operator training, in engineering experimentation, and more recently in sales activities.

An Ohioan, Mr. Wingard has a B.S. in rubber technology from University of Akron and did graduate work at Michigan. He also lives in Tulsa, and has four children in his family.

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8 PROBLEMS IN *Ethylene Manufacture &*

FULL-SCALE manufacturing and distribution of ethylene has been a reality for Gulf Oil Corp. at its Port Arthur, Texas, refinery, since February, 1953. What were some of the operating problems in this venture and how has Gulf met them?

1—Provision of a steady supply of raw materials.

2—Proper storage facilities for the finished product.

3—Choice of the ethylene formation step.

4—Purification, particularly sulfur and water removal.

5—Correct final separation.

6—Corrosion and coking in the cracking furnace.

7—Water removal throughout the process.

8—Delivery of product to the consumer.

A very important difference between ethylene manufacture and most typical oil refining is that it is an extremely high energy operation. Table 1 illustrates for comparison the manufacture of ethylene and a few common refining processes on the basis of power-inputs.

Although there will be differences in the requirements of specific designs of ethylene plants, catalytic cracking units, topping units, or lube oil solvent plants; differences between units of the same type cannot be great enough to destroy the relative positions in the comparison.

For a large scale chemical intermediate, ethylene has a high energy requirement per unit of product, and its manufacture involves the typical problems that one would anticipate from such a concentration of mechanical equipment.

1—Raw Material Supply

BECAUSE the operation of an ethylene plant starts with its raw-material source, and because, in the case of an oil company, this raw material may be either refinery gas or propane, the problem of continuity of raw-material supply becomes a fundamental operating consideration. If propane is to be used as a feedstock, conventional storage of a number of types can be provided, and at a cost which is not prohibitive.

If refinery gases—with their contained ethane, ethylene, and perhaps propane—are to represent the feed source, storage is not economically feasible, inasmuch as so much methane and hydrogen are contained in the cracked gases. When refinery gas is processed, the feed supply must be controlled by spilling; i.e., the ethylene plant will take as much gas supply as it needs, and will spill the remainder back to the refinery fuel system.

This may mean a substantial amount of excess compression, because the gas streams which are to be mixed must be sufficient to insure a relatively uniform composition to the ethylene unit. Even with such a spillback arrangement stable ethylene unit feed can only be obtained in a large refinery which has numerous gas-producing units.

Of equal importance is the effect which the ethylene unit off-gases have on the refinery fuel-gas system. Not only does the ethylene plant return the lower Btu components of the feed gas to the refinery; but, in addition, when the by-product gas from ethylene manufacture itself, which consists largely of methane and hydrogen, is added to the refinery fuel gas, the net result is that the Btu per cubic foot of the refinery gas stream is materially diminished. This need not be serious if proper provision is made for the accommodation of the changed nature of the fuel gas.

Successful operation of the ethylene unit must include the installation of the instruments and equipment, as well as the establishment of operating procedures, necessary to maintain reasonably uniform refinery operation in spite of any upsets to the refinery's fuel system caused by changes in the operation of the ethylene unit.

The installations may include equipment for flaring large volumes of gas during short periods of upset, or in case of failure of the ethylene plant equipment. In addition, the ethylene unit feed system must provide a feed-gas spill of sufficient volume to assure minimum upset of the ethylene unit when refinery units go off and on, or when the operating rate of the ethylene unit needs to be changed.

Table 1—Mechanical Energy Requirements of Processes

Type of Plant	Units of Saleable Product per Unit of Energy Input
Ethylene Unit	1
Fluid catalytic cracking unit	40
Lube oil solvent-treating unit	200
Crude oil topping and vacuum unit	700

2—Product Storage

IT is apparent that a stable ethylene supply is dependent upon more than a stable raw-material source. Storage must be provided for the ethylene itself. Gulf Oil Corp.'s distribution system involves more than 130 miles of pipe line, and the fluctuations in pressure which such a line can tolerate can provide a substantial amount of ethylene storage.

Although pipe line storage capacity serves to smooth out variations in producing-plant operations, Gulf has found that the needs of its customers, as well as the type of manufacturing operations involved, require a substantial additional amount of storage.

Any type of ethylene storage is exceedingly expensive; therefore, it is improbable that 30 to 60 days' storage will ever be attained, as is customary for most of the products of the oil industry. Nevertheless, a stable source of ethylene requires a substantial investment in ethylene storage.

The problems associated with ethylene storage are somewhat similar to those of the more familiar propane storage. In general, propane storage is costly because of the high pressure required at atmospheric temperature, or

Why an Oil Company Is in the Ethylene Business

Distribution and HOW THEY WERE SOLVED

because refrigeration is necessary if the storage is to be at low pressure.

The problems in ethylene storage are the same, only more so. The temperatures must be lower, and the pressures must be higher. Moreover, the lower density of the stored material requires a substantially larger storage volume for the retention of the same weight of stored material.

3—Formation Step

APART from equipment for feedstock preparation and product distribution, an ethylene unit consists of three fundamental parts. The first is the ethylene-formation section; the second is the purification section, with the equipment necessary for the auxiliary purification operations; and the third is the ethylene-separation section.

Several types of processes are available. By far the most common is that which employs some sort of externally-fired tubular coil by means of which the feedstock is thermally cracked so as to provide ethylene in a mixture of hydrogen and other hydrocarbons.

A number of other processes can be employed for the formation of ethylene, but the only other ethylene source used by Gulf is by-product ethylene contained in the refinery gases made in those cracking operations, either thermal or catalytic, designed to produce gasoline and other such oil products.

For the sake of the record, however, some of the other methods for the formation of ethylene should be mentioned. One which has been widely used in the past involves the dehydration of ethyl alcohol, much of which may have been produced originally from ethylene rather than from agricultural sources. This situation may seem strange at first; but it has been found expedient to go to the trouble of converting ethylene to ethanol, only to dehydrate that same ethanol later in order to produce ethylene for other purposes.

Ethylene is difficult to transport for any considerable distance because of its low critical point and light weight; and, under certain circumstances, it can be profitable to provide a crude-ethylene stream in an area where the ethylene is of little value, to convert that ethylene to ethanol, to transport the ethanol to a location where ethylene is needed but would not be available otherwise, and then to dehydrate in order to provide the ethylene.

Numerous other methods for the formation of ethylene have been used or proposed.

4—Purification Step

THE second part of an ethylene-producing unit contains the auxiliary purification equipment. Purification would include, to the extent necessary: the removal of sulfur, usually in the form of hydrogen sulfide or carbonyl sulfide; the removal of water; the removal of acetylene; and the removal of carbon dioxide.

Sulfur compounds and carbon dioxide can be removed by means of conventional processes such as amine and caustic solutions in series. However, these scrubbing towers, although conventional in type, must be operated for far more complete removal than is usually required. Sulfur compounds and carbon dioxide are undesirable for some of the uses for which ethylene is consumed; therefore, considerable attention must be given to insure that they are removed to the low parts-per-million level.

Acetylene can be lowered to the desired level by two general procedures: one by hydrogenation, and the other by solvent extraction with one of the several solvents available for that purpose.

Gulf Oil employs the former method, and passes the cracking-heater effluent, which is rich in hydrogen, over a selective hydrogenation catalyst under closely controlled conditions.

The most critical of all the auxiliary purification steps, however, is the removal of water. The feed to an ethylene unit separation section must be dehydrated to a very low dew point. With the very low temperatures of the ethane-ethylene fractionator, or the demethanizer, virtually all water must be removed in order to prevent the

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WHY should a petroleum refining company go into the making of ethylene? An understanding of Gulf Oil Corp.'s reasoning on this question will help show how the company met and solved subsequent problems associated with the actual manufacturing and distributing operations.

"One usually assumes that an oil company will be welcomed into the business of supplying ethylene to chemical processing companies simply because ethylene is a basic raw material, and because the larger profits come from its conversion to consumer products rather than from its basic manufacture," said Gulf.

"The capital funds of any company are not unlimited; therefore, management generally favors putting money into the higher-profit operations. Nevertheless, we believe that the principal attraction to the purchase of ethylene, rather than its manufacture, is not solely a matter of economics.

"Purchase of ethylene from a manufacturer whose plant is associated with a large refinery can represent a stable raw-material supply system. This can be extremely important to a company without an assured material supply.

"Refinery locations are for the most part stable, except perhaps for unusual changes in political and social environment, or a dwindling supply of a very special crude oil necessary to a very small refinery. Likewise, the flow of crude oil to a given refinery has become stable through the installation of a network of pipe lines, or through the establishment of a substantial fleet of tankers, or both. For the most part, the petroleum reserves of a refinery have been turned up a good many years prior to the present, and normal development of these reserves guarantees a substantial number of continued years of refinery operation.

"On the other hand, many chemical companies which manufacture their own ethylene have, in recent years, been faced with erratic LPG prices. Unusual weather of one sort or another has, on numerous occasions, sent LPG prices spiralling upward. The cookstove and space heater can pay a great deal for fuel if the need arises, and there is an old adage that, in a period of shortage, the manufacturing plant cannot compete with the cookstove for these materials.

"This is particularly serious for the manufacturer whose competitor is not at the same disadvantage as regards his raw-material supply. An ethylene contract therefore is, among other things, a contract for raw material for a long term, and at a stable and equitable price."

formation of hydrates in the column. The removal of water, even to low dew points, is a well-known and well-understood operation, but its importance is such that too much drying capacity in an ethylene unit is highly unlikely. Moreover, one cannot be too careful in the operation of whatever drying equipment is available.

Some efficient form of solid desiccant generally is employed in order to achieve the required dew point. Because this is, of necessity, a cyclic operation, anything which can be done to diminish the load on the solid desiccant driers will simplify the operation of the plant. The first and obvious thing to do is to chill the feed for the purpose of eliminating the water at the closest practical approach to the point at which hydrates or ice would otherwise be formed.

A fairly recent development is the di- or triethylene glycol dehydration unit which is widely used in the natural-gas industry. Gulf Oil now has such a unit in operation on an ethylene unit, as a partial dehydrator which precedes the solid desiccant driers.

This unit consists of an absorber in which the gas stream which is to be dried is continuously contacted with triethylene glycol. The glycol absorbs sufficient water to lower the dew point of the gas 35 to 40° F. The rich glycol is charged to a stripper column from which the water is removed overhead, and the stripped glycol is returned to the absorber. Inasmuch as this is a continuous system, its operation is relatively simple. By this means the water load on the solid desiccant driers is reduced more than 50 per cent.

One very effective method for water removal employed in some ethylene units (but not in those which Gulf operates) involves the same type of freezing-out procedure sometimes used for water and carbon-dioxide removal in the feed-preparation section of liquid-oxygen plants.

5—Final Separation

THE third principal portion of a unit for the production of commercial ethylene is the section comprising the equipment necessary for the separation of the ethylene produced and purified by any of the methods described herein. One of the earliest of the separation methods practiced was chemical conversion to a final product. This has been done, to a large extent, in the formation of ethyl alcohol via the familiar sulfuric-acid extraction process.

Except for this or other chemical extraction processes, all ethylene separation systems employ three principal steps. These are the elimination of methane-and-lighter, the elimination of propylene-and-heavier, and the final splitting between ethane and ethylene.

A widely used method for elimination of methane-and-lighter from the gas charge to the separation system is that which involves reboiled absorption. This, incidentally, is the principle employed in the separation system of Gulf Oil Corp.'s first ethylene unit.

The process involves the passing of feedstock through a refrigerated column which employs an absorption oil and added reboiling. The bottom of this absorption column is provided with a stripping section which aids in the rejection of the methane and lighter constituents overhead. The fat absorption oil, with its content of ethylene-and-heavier, is then passed to succeeding fractionating columns for the separation of lean oil, ethylene, and the cracking-furnace recycle streams.

An alternate method of demethanization, and the one employed in Gulf Oil Corp.'s second ethylene unit, involves the use of a low-temperature fractionator. The gas charge is refrigerated to a low temperature at a pressure sufficiently high to condense in part the mixture which enters this column. From this tower methane-and-lighter is taken as an overhead product, and liquid methane is used as reflux. The bottoms product is passed to succeeding fractionating columns.

A modification of this low-temperature fractionation procedure which has been employed by some companies involves the use of the oxygen-plant fractionating technique. Charcoal adsorption is another process which can be used to demethanize.

After the methane-and-lighter is removed, the ethane and ethylene can be taken overhead in a conventional tower, except that refrigeration is required in order to condense this overhead product. The de-ethanizer bottoms contain propylene and heavier materials. This bottoms product may be recycled to the cracking furnaces, but usually any C_4's-and-heavier present will first be separated out as a product stream. Many units recycle the total C_3 stream to extinction. But because propylene itself is valuable and because it is a less desirable material for charge to cracking furnaces which produce ethylene, it is often removed before the propane is recycled.

Propylene present in the charge to the unit, or in the recycle propane stream, may be removed in conventional fractionating equipment. This separation is relatively difficult, however, particularly if high-purity propylene is required for other petrochemical operations.

Another means of recovering the propylene, and the one used by Gulf Oil, is to charge the whole propane-propylene recycle stream through a catalytic polymerization unit, and to recover it as high-octane motor gasoline and tetramer. The propane effluent is then a more desirable feed to the cracking furnaces.

The overhead from the de-ethanizer is charged to an ethane-ethylene splitter. The ethylene product is taken overhead, and the ethane bottoms are recycled to the cracking coils.

Refrigeration is the heart of the plant. As was mentioned before, ethylene manufacture is a project—"only more so." The separation of butane and *iso*butane can be achieved in conventional fractionation equipment at regular cooling-water temperatures.

Such is not the case, however, with the ethane-ethylene separation, inasmuch as these materials would be above their critical temperature if conventional cooling water were employed. As a matter of fact, increasing the pressure is only a partial solution, because the separation of ethane and ethylene is pressure-sensitive in the sense that, at increasing pressures, the separating efficiency decreases sharply.

For ethylene of high purity, it is necessary to fractionate at moderate pressures, and this requires refrigeration temperatures well down in the sub-zero deg. F. range. Cascade refrigeration is required in order to obtain the low temperatures for the demethanization step in the processes used by Gulf Oil, and this refrigeration may or may not be used in the ethane-ethylene separation. Here the low-level refrigerant is most generally ethane or ethylene. This, in turn, is condensed with the high-level refrigerant, usually propane, which is condensed with conventional cooling water.

Cascade refrigeration is not at all new or novel, but the fact that each level of refrigeration must be in satisfactory operation before the next lower level of refrigeration can be brought on stream compounds the difficulties in operating equipment of this type.

Once again, however, the analogy between a conventional refining unit and an ethylene unit is a matter of "only more so." Not only does a column of an ethylene unit have to be in equilibrium so that it does not upset the operation of a succeeding column, but the reflux for some of these columns cannot be obtained unless the cascade refrigeration is operating properly.

Inasmuch as any ethane or ethylene

used for refrigeration very probably is produced within the ethylene unit, and inasmuch as this refrigerant must be relatively pure in order to provide the control necessary in the refrigeration system, the operation of an ethylene-separation unit is a kind of "lifting by the bootstrap" operation. It is no longer a simple matter of trying to operate a group of towers in series, with each column feeding the one following. The refrigeration systems are probably interlocked, and they compound the operating problem.

There is a great deal of temptation to save equipment by the interlocking of operations through a number of internal recycle streams. Often equipment is saved; and it is true that equipment saved is equipment which doesn't have to be operated.

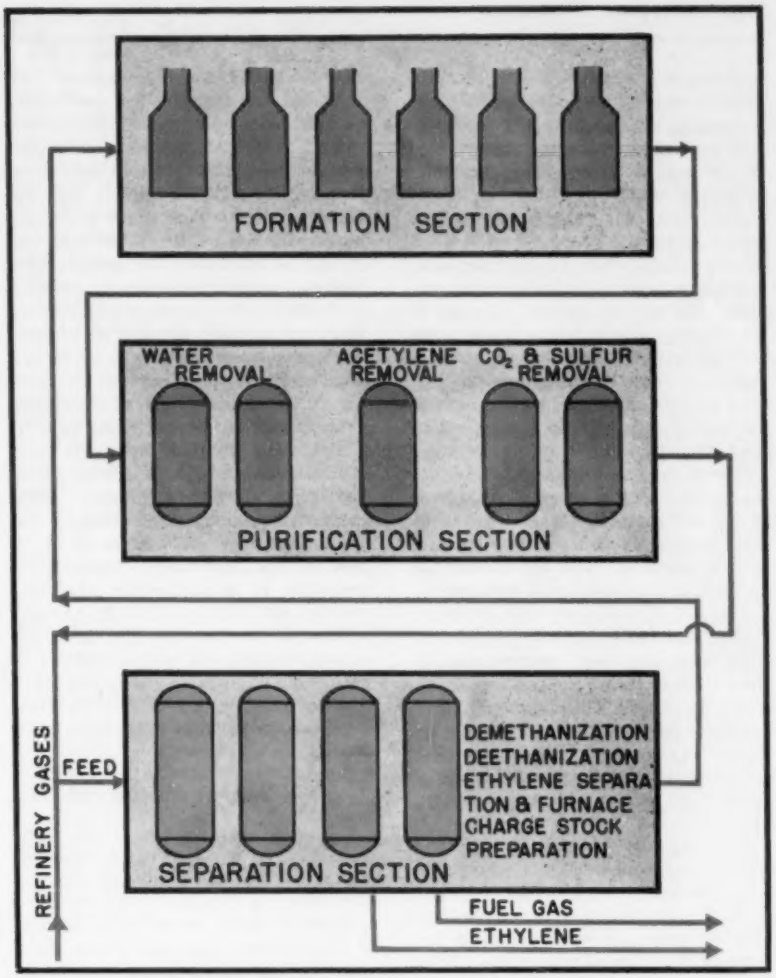
However, some of these simplifications can complicate the operation of the unit more than the equipment elimination can simplify it. This is particularly true during startup, because then the operator is seldom blessed with recycle streams and, especially, refrigerants of equilibrium purity.

Such variations from normal conditions are particularly important in a plant which uses centrifugal compressors. Such machines, by their general character, are very critical to changes in gas density. Like a centrifugal pump, each impeller increases pressure by so many feet of head of the fluid handled. But, unlike a pump, the density of the fluid changes through each impeller. Thus any change in density at the suction is amplified at each stage and may end up as a discharge pressure very different, in pounds per square inch, from that of the design. This discharge pressure cannot be compensated for by changes in quantity, as in the case of the reciprocating machine, because the head-vs.-quantity curves of most of these machines are very flat. Thus the limits of variations, as well as the normal operating point, must be considered in the design of such a unit.

6—Furnace Problems

THE dehydrogenation of ethane or the cracking of propane so as to produce ethylene is, in Gulf Oil Corp.'s units and many others, achieved in a tubular coil. The tubes are fired on the outside, and the feedstock plus steam pass through the inside. The conventional thermal cracker employs a furnace whose coil outlet temperature seldom exceeds 1,000° F.

Once again the comparison with an ethylene unit is a matter of "only more so." Here the coil outlet temperature is some 500° F. higher than that of the conventional thermal cracker. This is possible only because the feedstock is extremely clean. Although the clean feedstocks minimize many problems, the metals problems associated with the higher tube-metal temperatures are still there.



THREE MAJOR STEPS make up the manufacture of ethylene

In order to operate cracking furnaces with tube-metal temperatures above 1,500° F., it is necessary to use high-alloy tubes. All tubes in this service, so far as is known, contain nickel. In Gulf Oil Corp.'s furnaces 18-8 stainless-steel tubes are used in the lower-temperature section of the furnaces. In the higher-temperature sections there is Inconel, Incoloy, and 25-20 stainless steel.

Some information has been published on the relative tube life which is to be expected from some of these alloys. Gulf feels that it will take several more years to evaluate properly these different alloys, or even to say whether the cost is justified.

A few established facts regarding tube life which Gulf has confirmed are:

1. Welding must be perfect.
2. Increased coking shortens tube life.
3. None of these alloys is satisfactorily self-supporting at these temperatures of distances over about 4 ft.

Operation of an ethylene cracking furnace is a matter of the minimization of coking. There are probably as many ideas on how to minimize coking as there are operators of thermal cracking equipment. The principles, however, are the same for both the conventional thermal cracker, or thermal reformer, and the ethylene-producing unit.

These are to keep the mass transfer up, to keep the feed clean, to maintain proper temperature gradient, and to keep charge and firing rate constant. Provision for a quenching system which is rapid and effective is essential. With much higher temperatures, much lighter materials, a substantial amount of hydrogen in the effluent stream, and no liquid condensation to aid heat transfer, the problem of quenching once again becomes a matter of "only more so."

The matter of coking involves the

problem of reaching a proper compromise between the elimination of coke formation, inasmuch as it tends to decrease operability, and the achievement of the benefits from the higher temperatures and other conditions of higher feedstock conversion which tend to aggravate coke formation. Gulf do not believe that it is economically feasible to try to eliminate coking entirely. Rather, the proper solution to the whole problem seems a matter of learning how to live with coke formation, and then learning how to take such steps as are necessary to minimize the interference with operations which coke formation might otherwise cause.

One of the best means of solving the coking problem in an ethylene unit is to provide extra heaters, or sufficient extra heater capacity, so that heaters may be removed from service without decrease in the capacity of the unit.

The use of a diluent such as steam in the cracking-heater tubes serves another very important purpose, totally apart from its usefulness in suppressing coke formation. Because ethylene heaters must come down at regular intervals for coke removal or repairs, the unit is most properly made up of a number of relatively small cracking furnaces.

To bring these furnaces down without effecting a substantial change in the throughput of the plant requires that fresh furnaces be brought onto the line. This is generally best achieved by bringing them up to temperature with steam passing through the tubes, and with sufficient fire in the box to achieve the necessary temperatures.

Once the furnace is in approximate equilibrium, feedstock can be cut from the furnace which is being taken out of service and put into the furnace which is being placed in service with a minimum of upset to the separation section of the plant.

A theory has been advanced that coking of the heaters is influenced by the type of materials used in the heater tubes. This theory stems from the knowledge that some materials of construction are catalytic for the formation of coke. Although Gulf does not intend to debate the point, and tube material may be a factor in the formation of coke, the company has not found a tube material which will eliminate coke formation. Therefore, although selection of the proper tube material may decrease coke formation somewhat, spare furnaces and a means of decoking while the rest of the unit remains in operation is seen by far the most fundamental solution to the problem of continued operation of the ethylene-formation section of the unit.

While the decoking operation need not be mechanical, the operation of the furnaces and, for that matter, other parts of the ethylene unit requires that a great deal of mechanical work be done on the units while they are in operation, or at least while other sections of the plant continue to operate.

This means that the unit should be so constructed, and so laid out, as to permit the necessary welding and other types of maintenance work to proceed even though the unit itself remains in operation.

7—Water Removal

ALMOST everyone who has operated a variety of fractionating equipment has, at one time or another, had difficulty because of the presence of water in the fractionator. In the case of an ethylene unit, the presence of water is once again a case of "only more so."

Here the temperatures are sufficiently low, and the pressures sufficiently high, that any water present will form hydrates with the hydrocarbons, and these hydrates will accumulate so as to produce an ice plug which may render the column incapable of passing its required vapor or liquid load.

Methanol is used as a means of minimizing hydrate formation, if the means of getting the methanol to the proper place in the column is available. Methanol is, at best, only an emergency answer to the problem, however; complete feed dehydration is the most desirable solution.

The problem of water removal has so important a bearing on the operation of an ethylene plant that the customary procedure of steaming out for removal of hydrocarbons is not satisfactory when it comes to the starting up or shutting down of an ethylene unit. Although the steaming-out process will achieve the purging desired, the water introduced into the unit prolongs the drying-out time necessary when the equipment is started up. This, coupled with the necessity for starting a number of columns in series and for obtaining refrigerant to get the system into equilibrium, complicates matters unnecessarily. Gulf has found it a desirable solution to install an inert-gas generator which is equipped with driers capable of providing a low-dew-point inert gas for purging.

It is also apparent that the existence of sufficient accumulator capacity to permit storage of enough internal recycle streams of equilibrium composition is a substantial aid to the starting up of the unit after it has come down for a temporary shutdown or for minor repairs.

8—Product Delivery

GULF Oil Corp. delivers ethylene from producing units to consumers via a pipe-line system which it has installed, and which serves not only Port Arthur, but also the Orange, Houston, and Texas City, Texas, areas. The operation of this pipe line is once again a matter of "only more so." In the measuring of a relatively valuable gaseous material, such as ethylene, the degree of metering accuracy required is far greater than that normally found to be adequate.

For this reason Gulf has found it necessary to determine more accurate values for true gas-law deviations than those previously reported in the literature for ethylene. Ethylene pipe-lining and measurement require special installations which involve better-than-average pressure-reducing stations, orifice runs, measuring equipment, and the like.

For practical reasons an ethylene pipeline will normally operate at pressures considerably in excess of those desired by the ethylene consumers. This necessitates a substantial reduction in pressure at the meter station, and the throttling necessary may be sufficient to cool the metered stream to 0° F. or lower. Although this is neither unexpected nor unusual, it does tend to introduce another problem into the accurate metering of the amount of ethylene delivered, and suitable equipment must be installed in order to minimize this problem.

Both operations and maintenance of the ethylene pipe line are handled by the Pipe Line Department of Gulf Oil Corporation. Coordination and operational control of the line rest with the 24-hour-per-day dispatching center in Gulf's Houston pipe line offices. Private-line telephone service is available from this center to each customer or Gulf facility which has a metering station handling ethylene.

NOTE: The preceding article consists essentially of the paper, "Large Scale Manufacture and Distribution of Ethylene," by P. W. Cornell, Gulf Oil Corp., Pittsburgh, Penna., and W. H. Litchfield and H. M. Vaughan, Gulf Oil Corp., Port Arthur, Texas, presented at the 19th Mid-Year Meeting of the American Petroleum Institute's Division of Refining, Houston, May 12, 1954.

Do You Know These Words?

By B. H. WEIL
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Butylene Oxides

Butylene Oxides, pronounced **"beu**-tih-lean **ock**-sides," are petrochemicals which have been available commercially for little more than a year. They are water-white liquids which boil from 122-153°F. (143-149°F. for the straight-chain isomers). Chief among the latter is said to be the 1,2-butylene oxide, which has the formula $CH_3{\cdot}CH_2{\cdot}CH{\cdot}O{\cdot}CH_2$.

Butylene oxides are obtained by the hypochlorination (reaction with HOCl) of butylenes, followed by reaction with lime. They are available as "mixed isomers" (containing isobutylene oxide) and as a mixture chiefly composed of the three straight-chain isomers (1,2-butylene oxide, *cis*-2,3-butylene oxide, and *trans*-2,3-butylene oxide). Preparation of the latter mixture requires further processing of the mixed isomers for removal of isobutylene oxide, whose presence is said to interfere with polymerization reactions when the butylene oxides are used for that purpose.

The butylene oxides are of commercial interest for the same types of reactions as ethylene oxide and propylene oxide (polymerization and condensation). They may be substituted in part or whole for these "epoxide" chemicals in the synthesis of detergents, emulsifiers, plasticizers, intermediates, and hydraulic fluids.

Butylenes for the synthesis of such products are available from refinery cracked gases, or may be produced from butane by catalytic dehydrogenation. While the butylene oxides are not yet high-tonnage petrochemicals, they are interesting examples of new products which may be added to the "workhorses" of the chemical industry.

Fumaric Acid

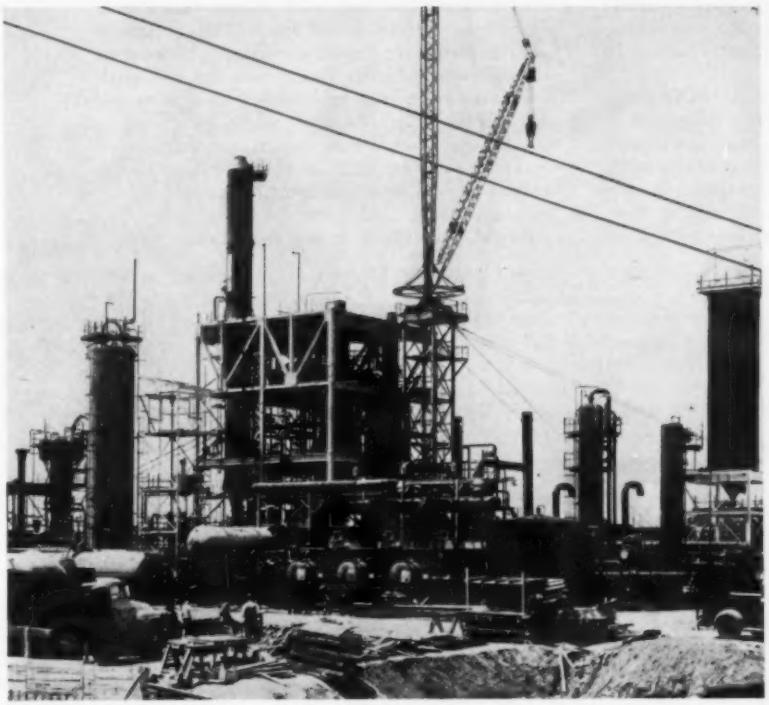
Fumaric Acid, pronounced "few-**maer**-ick **ass**-id," is a white to yellowish crystalline material which in recent years has become a petrochemical because of its production from benzene. It has the formula HOOC·CH:CH·COOH, and is the "trans" isomer of another chemical having the same formula, maleic acid; that is, its two ·COOH groups do not occur in space on the same side of the molecule, whereas those of maleic acid (the "cis" isomer) do. Fumaric acid has a specific gravity of 1.625 and a melting point of about 550°F.

This substance may be produced by the fermentation of molasses, but it is also being manufactured in quantity as a co-product from the catalytic oxidation of benzene to yield maleic acid, and by isomerization of maleic acid itself. It has a variety of uses, chief among which are the synthesizing of heat-resistant polyester resins (for laminated and reinforced "plastics"), superior alkyd resins (for paints, varnishes, etc.), and fast-drying printing inks; the upgrading of natural oils used in varnishes; and the acidulation of gelatine desserts.

As mentioned frequently in this series, petrochemical benzene is produced by the catalytic reforming of naphthas, followed by separation. This development of the past few years has opened the floodgates to a sea of new petrochemicals, among which fumaric acid finds its place.

Recent developments indicate that increased quantities of fumaric acid will shortly be available, presumably to meet expected growth in demand for polyester and alkyd resins. As prices decline with growing output, moreover, fumaric acid is expected to serve as a building block for the synthesis of a wider variety of chemicals.

NEWS in VIEWS



GASOLINE FROM COAL plant, using Synthol process, is now about 60% complete. Being built by M. W. Kellogg for SASOL, the South African Coal, Oil, and Gas Corp. Ltd., near Johannesburg, complete plant covers some 5000 acres and will represent total investment of around $85,000,000. Operating on 7600 tons/day of nearby coal, it will produce about 1,300,000 bbl/year of gasoline, as well as fuel oil and gas oil. In addition, approximately 15,000,000 gals. of chemicals will be produced annually.

These will include ethyl, propyl, and butyl alcohols, methyl ethyl ketone, and acetone among the oxgenated hydrocarbons, as well as significant quantities of ammonium sulfate, benzene, toluene, xylene, crude tar acids, and creosote.

South Africa has no known deposits of commercial petroleum, and utilization of its large coal reserves is seen as a tremendous help in filling the existing gap in the country's strategic and economic resources. The Synthol process catalytically reacts gases from the controlled combustion of coal.

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When you find oil, you strike it rich. When you get high processing yields from that oil, you strike it richer. ADSCO helps refineries get the most out of its crude by designing and manufacturing heat exchangers efficiently suited to their process . . .

An outstanding example of ADSCO engineering is the installation shown above in a Perth Amboy, N. J., refinery. Here is a liquid-to-liquid heat exchanger consisting of two units arranged in series. The engineers specified only that one liquid was to be cooled from 190° F to 100° F, the other to be heated from 75° F to 165° F. From then on the problem was ADSCO's and ADSCO developed the most economical design in competition with several other heat exchanger manufacturers. Each of the two units has two passes on the tube side and, because of a longitudinal baffle, two passes on the shell side. This permits a counterflow design to get the maximum heat-transfer efficiency. Were it not for the counterflow design, the exchanger would have to be built in three or four units, instead of two, thus increasing the cost . . .

ADSCO cordially invites inquiries.

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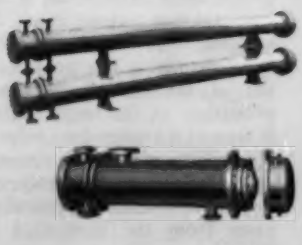

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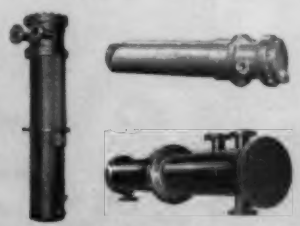
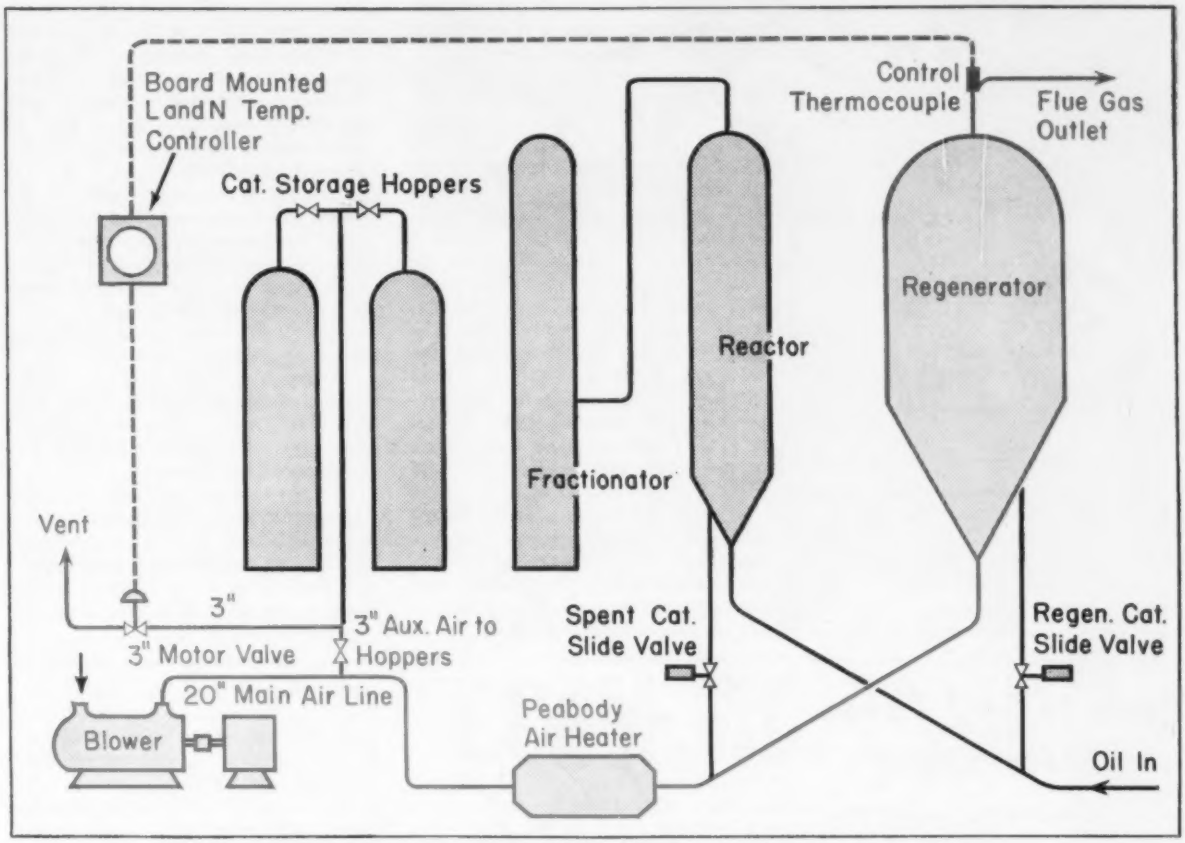


(To obtain more data on advertised products see page 1112)



REGENERATOR TEMPERATURE IS REGULATED by small control valve on a vent line from the regenerative air flow line

Simplified Control of Carbon Laydown

By HOLLIS A. SPENCER, Operating Foreman, Frontier Refining Co., Cheyenne, Wyo.

A RELATIVELY simple instrumentation scheme has overcome a problem of carbon laydown and after burning in the Fluid catalytic cracking unit at the Cheyenne, Wyo., refinery of The Frontier Refining Co.

Essentially, it consists of adjusting flow in a vent stream from the main air supply to the regenerator and monitoring this flow by a temperature controller actuated by a thermocouple in the regenerator flue gas outlet, as shown in the schematic flow diagram above.

The problem followed a revamp of the cracking unit recently. The work included a new centrifugal blower for regenerator air to replace the old reciprocating compressor. Also installed were new high pressure steam generation equipment, slurry settler, regenerator grid, cyclones, and new flue gas lines.

It was found impossible to control temperatures in the regenerator with any degree of accuracy, after the revamped unit went back on stream late in January. Carbon laydown on the catalyst was subject to extreme variation, and the unit was generally difficult to control.

Use of quench water in the regenerator caused excessive loss of catalyst, and after-burning was a continual problem. The use of torch oil in the regenerator seemed to be the most reliable method of controlling the CO_2:CO ratio, because this provided closer control than changing the speed of the blower.

However, the continued use of the torch oil was undesirable as a method of control, because charge stock was being used for this purpose. Presently accepted beliefs are that this is quite harmful to catalyst activity. No success was had with still another approach: controlling carbon laydown by changing slurry recycle rates and by changing reactor temperatures.

Operation got so rough that within two months of the start-up, one man was devoting most of his time to watching regenerator temperatures and continually changing air rates and torch oil rates in an attempt to prevent excessive carbon level and afterburning.

At this point, the operating department conceived the idea which worked out as a solution to the problem. This idea was that it might be possible to overcome the unwanted conditions

Table 1—Processing Conditions in Frontier's FCC Unit

	Reactor	Regenerator
Pressure, psi.	17.8	16.7
Dense phase temp., °F.	885	1160
Dilute phase temp., °F.	—	1175
Combined fd. temp., °F.	226	—
Catalyst, tons	9.12	24.2
Slide valve, Δ P	5.85	1.8
Circ. rate, tons/min.	6.79	—
Riser air, SCFM	—	13,500
C/O ratio	9.7	—
Regen. catalyst carbon, wt.-%	—	0.21
WHSV	4.61	—
Slurry return, b/d	1230	—
Flue gas: CO_2	—	12.4
CO	—	5.4
O_2	—	0.8

Approximate charge rates:
2550 b/d of 28° API gas oil, 0.07 Conrad. Carbon.
2900 b/d of 39.4° API crude oil, 2.52 Con. Carbon.

with a small side stream of air, vented to the atmosphere from the regenerative air line through a control valve actuated by a temperature controller.

This control setup would be required to maintain a small temperature differential between the regenerator dense phase and the flue gas outlet. The control valve would, therefore, open when a rise in flue gas temperature indicated excess air and would close when temperature dropped.

Due to the fact that an instrument of this type was not immediately available, it was first decided to install the control valve and then operate it with a manual air setting to prove its possibilities. This preliminary installation proved a step in the right direction.

A temperature controller (Leeds & Northrup) was then hooked into the control valve, as indicated in the drawing, using the regenerator flue gas temperature as the control point. The instrument was set to position the valve from fully open to fully closed with a 5°F. variation in flue gas temperature. The controller index was set at 1165°F. Dense phase temperature in the regenerator at this time was 1160°F. (See Table 1).

Within ten minutes after the instrument was put into operation, temperatures in the regenerator had lined out, the unit had settled down, and it was running more smoothly than it had at any time since startup in 1944.

Since the control was installed, regenerator dense phase temperatures have never varied more than 2 or 3° on a given charge stock. If a change in charge stock requires a different air rate, the blower speed is changed sufficiently to bring the instrument back on control and the index is reset to accommodate any change in dense phase temperature.

Quench water and torch oil no longer are being used, and afterburning is likewise no longer any problem. The cracking unit has gone through a major upset and the control performed beyond any expectations while cleaning up black catalyst and controlling the ensuing afterburning.

Although sufficient data has not yet been collected for definite proof, it is felt that it will be possible to maintain any given carbon level with this new control arrangement.

If heat balances are such that the regenerator temperatures are in the range of 1170 to 1200°F., the value of this control becomes even more apparent due to the susceptibility of afterburning resulting from the increased regenerator temperatures.

How to Sell Those Safety Shoes

By J. H. McKENZIE, Safety Mgr.
General Petroleum Corp.,
Los Angeles, Calif.

"OUCH! My aching toe!"

With a well-established program for safety shoes, such woeful cries are seldom heard. In our operations—an oil company covering 11 western states with personnel pretty well distributed over the territory—a safety shoe program offered a challenge, a challenge to find the best method of getting shoes to the men and men into the shoes.

Our first attempt, in 1944, was to stimulate interest in the program so that the men would—on their own—purchase safety shoes. We established a procedure whereby the employe, on presentation to his foreman of a vendor's invoice or sales slip indicating he had purchased a pair of such shoes, was given a refund of 25% of the sale price.

This met with a degree of success, but it did not reach the goal we had set out to attain which was 100% of our field personnel in safety shoes. Since it was 1944, it was during a period when shoes were being rationed on account of the war. Extra shoes stamps were obtainable for the purchase of safety shoes, and naturally this encouraged employes in their purchase, but not quite enough.

The next attempt was started a little over three years ago when the company management gave an OK to carry safety shoes as an item of warehouse stock with distribution to be handled on a mail order basis. This OK was given on the condition that some suitable means of measuring the feet be established so that people in the field would be assured of a properly fitting shoe.

Solution to that problem was worked out like this. First, a very small stock of shoes was carried as a test at the warehouse, and shoes were sold only to those working in the immediate area. A very inexpensive measuring device supplied by the vendor was used for determining the sizes. After 100 pairs of shoes had been sold, it was found that as long as this particular device was used the employe obtained the correct size shoe. Only when an employe insisted that *he knew* what size he wore and that it was *unnecessary* to use the measuring device did we have trouble.

We then put the project on a company-wide basis, stocking the different types necessary for the various jobs. This meant, in our case, four different styles. Purchases were to be made through the foremen. The standard requisition form required for all items commonly used throughout the company was to be used. These requisitions came through the regular mail system, and shoes were sent parcel post to the location where the employe worked. Unless it is an unusual size, —say No. 14—it takes about a week for delivery of shoes. Unusual sizes are ordered from the factory and require a period of three weeks for delivery.

It was seen early that it would be desirable to give employes a chance to inspect samples. That way they could check on the nature and the quality of the shoes being offered.

We did this by having sets of sample shoes for use by the divisions and the plants. Each set consists of one each of the four different types of shoes being stocked. They are packed in a sturdy, plywood case suitable for carrying or for shipping, along with one of the measuring devices.

The sample sets can be used for display and then for preparation of orders as they are sent around the company. For that reason, a set was provided all of the key operating locations, and a designated individual (in some cases the safety man) was held responsible for bringing to the attention of all employes the fact that safety shoes were available. Besides this, posters were made and distributed, and a general bulletin was released to all employes, as follows:

"To further encourage the wearing of safety shoes by employes, additional procedure has been established which will permit the purchase of safety shoes by payroll deduction. This will enable employes to obtain safety shoes in any of the following three ways:

"1. Purchase from outside vendor. Employe will present to his immediate supervisor the vendor's invoice or sales slip covering cost of the safety shoes. Employe's supervisor will inspect the shoes purchased and if he determines that the shoes may be classed as safety shoes with steel reinforced toe construction, a refund will be made to the purchaser in the amount of 25% of the sale price, with a minimum of $1.00.

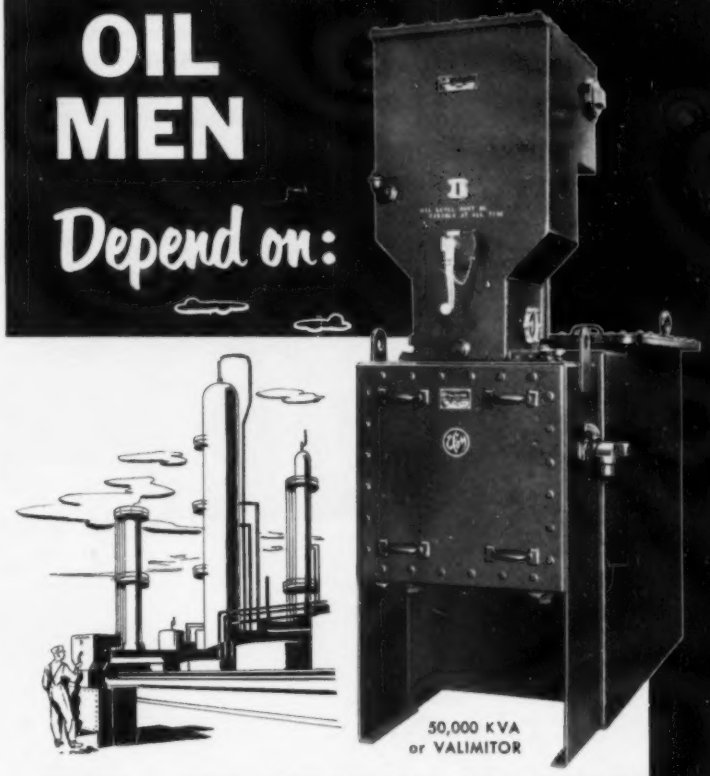
"2. Cash purchase through company stores department. Employe will obtain from authorized person in his department a material requisition and deliver sheet, sending it to the nearest warehouse along with the price of the shoes as noted on the warehouse price sheet.

"3. Payroll deduction. Employe will obtain from authorized person in his department a material requisition and deliver sheet, sending it to the nearest warehouse, noting thereon that payment is to be by payroll deduction.

"To simplify the handling of sales in paragraphs 2 and 3 above, the price quoted on the warehouse price sheet will be the cost to the employe after allowing the authorized 25% discount."

A lot of people were skeptical—when this program was first established—as to whether it would work or not. However, we now supply safety shoes through this system to about 3300 employes, and during the last 18 months have sold 4400 pairs with only three complaints.

OIL MEN Depend on:



EC&M 2200-5000 VOLT Motor Starters

These EC&M Division 1 combination Starters for Class I, Group D hazardous locations give petroleum men top-value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and interrupting capacity is high . . . either 50,000KVA or in the VALIMITOR (volt-ampere-limitor) type, unlimited short circuit protection.

Oil disconnect switch (on top) may be locked open or closed, and has view windows on both sides to show switch contacts. Overload Relays of THERMAL-MAGNETIC type (mounted in conduit connection box) give accurate motor protection . . . trip instantly on faults.

Rear oil-tank has potential transformer for 220-volt push button circuit. 50,000 KVA type ZHS Magnetic Contactor may be inspected without disconnecting any bolts or leads. Contacts are copper tungsten alloy. VALIMITOR Starters, with air-core current-limiting reactors in rear tank, limit fault current to 25,000 KVA . . . ZHS Contactor clears circuit quickly. No fuses, no need to figure short possibilities . . . supply bus can be infinite KVA.

Before buying, investigate EC&M Combination Starters . . .they provide economy in installation, operation and maintenance . . . and they're complete in every respect.

1915

Write for 16-page Booklet 1062 on EC&M 2200-5000 volt starters.

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(To obtain more data on advertised products see page 1112)

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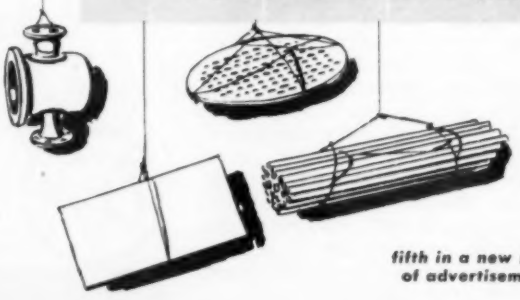
WESTERN'S *Selective* PURCHASING . . .

Builds better Heat Exchangers — FASTER!

Changing a set of blueprints to an actual piece of process equipment always starts with purchasing. Bungle this first step and carefully laid "paper plans" for economy wash down the drain. Once the Western rating engineers have assigned a work order number and the drafting section has compiled the preliminary bill of materials, experienced material clerks go to work carefully checking the list against Western's warehouse stocks. In the Tulsa warehouse (see photo above) large inventories of plate stock, tube-sheets, channels and channel covers, steel and Admiralty tubes are maintained. At Western's **purchasing** department SERVICE calls the play. Special materials have, on occasion, been ordered in **advance** of the client's own equipment purchase order . . . a risk taken by Western so that equipment could be moved quickly through fabricating when the green light was given. Close personal contact is maintained with local and out-of-state supply sources . . . a working arrangement that brings special materials to the modern Western heat exchanger plant via every possible means of transportation.

The process engineers at a large chemical plant recently discovered the beginnings of deterioration in Hexamine solution due to overheating. On Feb. 10th the company called Western . . . by Feb. 12th a 16", 10' fixed tube sheet exchanger had been designed . . . by Feb. 13th shell and tube side stainless steel parts had been located in the warehouse of a Tulsa metal company . . . EXCHANGER SHIPPED BY SPECIAL TRUCK FEBRUARY 25th — 15 DAYS FOLLOWING INITIAL INQUIRY.



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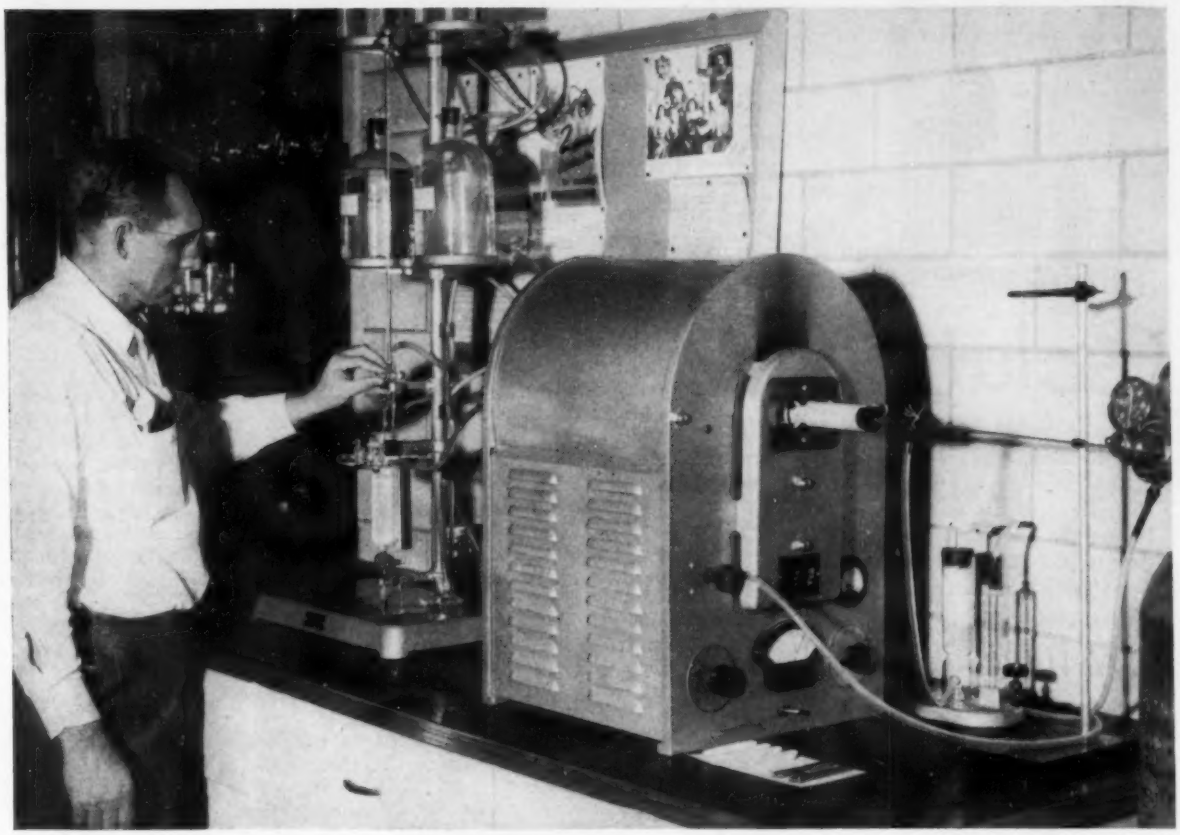

AS INSTALLED IN GASOLINE COMPANY LAB, combustion and titration combination . . .

Unit Cuts Sulfur Analysis Time by 94%

By H. J. ERICKSON and ROBERT E. LINDBERG*

A REDUCTION in sulfur analysis time from six hours to about 20 minutes has been made by Aurora Gasoline Co. of Detroit, Mich., as the result of a new technique adopted in the laboratory.

The company has replaced the conventional Bomb method (ASTM D 129-52) for sulfur content on products of low volatility, such as crude oil distillates and residual fuels, with the new technique.

Basis of the new technique is continuous combustion followed by titration. The equipment used is shown in the photograph above. Aurora has found it is applicable to all products they are handling that are covered by the standard ASTM Bomb Method.

Essentially, the procedure is to burn the sample in the combustion tube at a temperature of 2400° F. in an excess of pure oxygen. The gaseous products of combustion, containing sulfur dioxide, pass on into a dilute solution of hydrochloric acid with potassium iodide, using starch as an indicator. The titrating solution is potassium iodate. The reactions involved are as follows:

$$S + O_2 \rightarrow SO_2$$

$$KIO_3 + 5KI + 6HCl \rightarrow 3I_2 + 6KCl + 3H_2O$$

$$2H_2O + SO_2 + I_2 \rightarrow H_2SO_4 + 2HI$$

The equipment is assembled as shown in the illustration. It comprises a single, or a dual, combustion tube furnace ("Varitemp") with resistance heating elements; the "Sulfur Determinator" (a development of Harry W. Dietert Co.); a flow meter, oxygen tank, and a tower containing Drierite and anhydrone for drying and purifying the oxygen before it enters the combustion tube.

The sulfur determinator proper is an assembly for holding the bottles of solution, the burette, and the titration vessel. The burette is calibrated to read directly in % sulfur when a one-gram sample is used and the potassium iodate solution is made up to 0.2225 gm./liter. For convenience, the burette is of the self-filling, overflow type.

The combustion tube is connected by rubber tubing to a fritted glass bubbler which is immersed in the titrating solution. The fritted portion of the bubbler produces a small enough bubble to assure thorough contact of the gases coming from the combustion tube with the absorption solution.

The reservoir bottles holding the hydrochloric acid and starch-potassium iodide solutions are connected to stopcocks on the side of the titration vessel.

* Mr. Erickson is chief chemist, Aurora Gasoline Co., Detroit, Mich. Mr. Lindberg is associated with Harry W. Dietert Co., Detroit, which firm developed the new sulfur determination equipment.

Problem

To produce more ammonia without excessive expansion of existing facilities.

Solution

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75% more output

Girdler specializes in solving catalyst problems. Its knowhow is at *your* service.

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The GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
Gas Processes Division
LOUISVILLE 1, KENTUCKY
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Table 1—Comparison of Results on Routine Tests

Type of Compound	Sulfur, wt.-% Bomb Method	Sulfur, wt.-% Determinator
Sweet crude oil	0.21	0.21
Sour crude oil	1.87	1.89
Bunker C fuel oil	1.34	1.35
Bunker C fuel oil	0.96	0.94
Burning oil	0.34	0.35
No. 2 fuel oil	0.25	0.24
Range oil	0.12	0.12

Two lines are scribed on the titration vessel—the lower one indicating the amount of acid (50 ml.) and the upper one indicating the amount of starch-potassium iodide solution (15 ml.).

Solutions are prepared as follows:

Starch solution: Weigh out 2.4 grams of Lintner's starch and add 7 ml. of distilled water to make a smooth paste by stirring. Add this paste slowly to 500 ml. of boiling water, stirring rapidly. Cool, add 4 grams of potassium iodide and bring the volume up to 2000 ml.

Hydrochloric acid solution: Mix 40 ml. of concentrated hydrochloric acid (specific gravity, 1.190) and 1960 ml. of distilled water.

Potassium iodate: Dissolve 0.2225 grams of potassium iodate in about 900 ml. of distilled water and dilute to exactly one liter.

These solutions are designed so that each ml. of potassium iodate is equivalent to 0.001 grams of sulfur when a one-gram sample is used.

Samples are weighed into pre-burned combustion boats which have a layer of pre-burned alundum on the bottom. The boat is then covered with a nickel combustion retarder cover to prevent too rapid vaporization of the sample with the attendant risk of explosion. The weight of sample used depends on the sulfur content of the oils being tested, as shown in the following table:

Material	Temp. °F.	Sample wt., gms.	Approx. % sulfur
Bunker fuel oil	2400	0.1	1.0
Lube oil	2400	0.3	0.3
Tars	2400	0.1	1.0
Crude oil	2400	0.2	0.5

Fifty ml. of the dilute hydrochloric acid and 15 ml. of the starch-potassium iodide solution are added to the titration vessel. One drop of potassium iodate solution is added to give an initial coloration of the absorption solution. The burette is then refilled, thus canceling out any blank determination. The sample is then placed in the front end of the combustion tube, and the tube is sealed with a rubber stopper through which a steel pusher rod extends.

After the tube is closed, oxygen is admitted at the rate of 2 liters/min. The sample must be pushed into the hot zone of the combustion tube slowly to eliminate the possibility of an explosion. Explosions may be completely eliminated by carefully following all operating instructions.

As the sulfur dioxide flows into the absorption solution, it tends to become colorless, and potassium iodate solution is added to keep the solution a light blue color. The combustion boat is pushed into the furnace slowly until the absorption solution shows no more tendency to decolorize. With practice, it will be found easy to match the color at the end point with the initial color developed by adding one drop of iodate solution before combustion begins.

A typical comparison of results obtained by the new procedure and the ASTM Bomb method on a variety of materials is shown in Table 1. These results seem to indicate a satisfactory accuracy for the new method. A similar comparison is shown in Table 3, data from the original series of tests run by Aurora Gasoline Co. to determine the precision which might be attained.

The combustion-titration equipment has been in use almost a year now. In addition to less time for each sulfur determination—20 minutes instead of 6 hours as stated previously—the new method requires little in the way of equipment maintenance. About the only thing needed is the occasional replacement of combustion tubes and heating elements. Furnace elements need replacing about once a year and combustion tubes need replacing only on breakage. The only other operating cost is that of the combustion boats—Aurora uses about 100 in a year's time.

Table 2—Results of Original Tests for Precision of Method

Type of Material	Sulfur, wt.-% Bomb Method		Determinator	
Bunker C fuel oil	1.51	1.50	1.51	1.51
Fuel oil	0.91	0.93	0.90	0.92
Catalytic cracker charge	1.25	1.22	1.23	1.22
No. 5 fuel oil	0.75	0.73	0.74	0.73
Crude oil	0.19	0.20	0.20	0.21

 (To obtain more data on advertised products see page 1112)

Above unretouched photograph shows the "guts" of the original 2" style 50 single ball race CHIKSAN Swivel Joint after 20 years of rigorous service in the California oil fields. Note the good condition of the wearing surfaces. This joint has been improved through the years to the present modern double ball race joint.

The CHIKSAN Ball Bearing Swivel Joint illustrated above is an unretouched photograph of a veteran of 20 years service on an oil well cementing hose.

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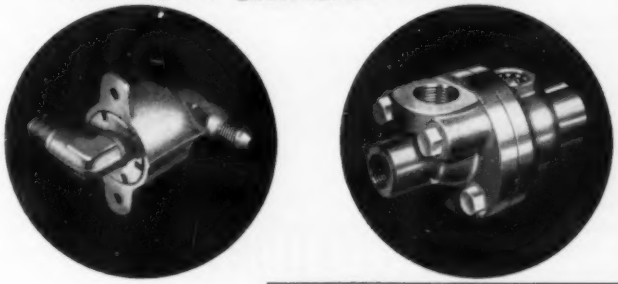

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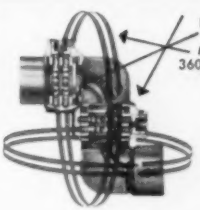

CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles, and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 70° to a plus 500° F. with packing materials for each specific service.

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Just look at the difference...

Figs. 1 and 2 are representative of results obtained in a test conducted by a major oil company in an area where an abnormal number of sludge complaints in domestic heating systems were received.

Fig. 1 shows a typical filter element as removed from one of the heating units after running on untreated fuel. Fig. 2 shows an element at the end of a 90-day test period in which the same fuel plus Fuel Oil Additive No. 2 had been used in the system.

This, and other findings in the test, indicated that Du Pont Fuel Oil Additive No. 2 acts as an active sludge dispersant in concentrations of 20 lbs./1000 barrels and that its use in dirty fuel oil systems is generally beneficial.

Increase your heating oil market with

DU PONT FUEL OIL ADDITIVE No. 2

The prevention of filter clogging is an important sales and servicing advantage . . . and customer satisfaction is becoming increasingly important in every heating oil market. One way of assuring this satisfaction is in the prevention of clogged filter screens or lines.

To help overcome clogging, Du Pont Fuel Oil Additive No. 2 not only retards the formation of insoluble residues, but also reduces the particle size of those residues that *are* formed.

Actual field tests, of which the filter elements illustrated above are a part, show also that Fuel Oil Additive No. 2 acts as a sludge dispersant in dirty fuel systems and, being ashless, burns completely with the fuel.

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Samples for testing in your own stocks and a descriptive booklet on this additive can be obtained from any Du Pont Petroleum Chemicals Division representative or regional office.

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OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Del.

By Peter J. Gaylor, Patent Attorney, Elizabeth, N. J.

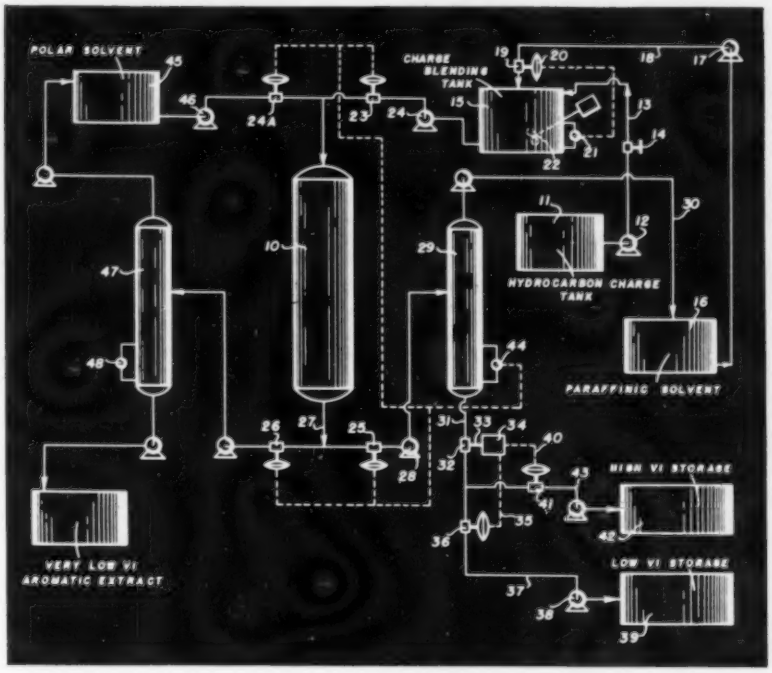

FIG. 1—Process for producing lube oils in which all components have high V.I.

Silica Gel Percolation Aids in Method For Producing High V.I. Lube Oils

THE preparation of a high viscosity-index petroleum lubricating oil in which the only components present are those having high viscosity index, is disclosed in U. S. Patent 2,674,568 issued to Standard Oil Development Co. The process employs silica gel percolation to separate low V. I. components from those having high V. I.

Paraffinic and aromatic naphthenes employed in the lubricating oil of the patent may be characterized by the following formula:

$$M\ (n_D{}^{20} - 1.4750) < 8$$

in which M is the average molecular weight and $n_D{}^{20}$ is the index of refraction at 20° F. of said naphthenes using the sodium D line.

The numeral 1.4750 is obtained by plotting the reciprocal of the molecular weight of a large number of hydrocarbons of different types against the refractive index of these hydrocarbons to obtain a series of straight lines. Each type of hydrocarbon will follow along a separate straight line but all hydrocarbons of the same type will follow in the same line.

These lines are not parallel to one another and may be extended to a point corresponding to infinite molecular weight at which they converge. The point of convergence for infinite molecular weight occurs at a refractive index of 1.4750 when using the D line of sodium at a temperature of hydrocarbons of 20° C.

It is said to have been observed that the various hydrocarbons in lubricating oil fractions have factors, as determined from the foregoing equation, which vary widely. Generally, it has been found that paraffins have values (F) or factors determined from the foregoing equation substantially less than 8 and similar values have been found for the naphthenes.

On the other hand, the aromatics have values or F factors as a general rule above 8 while the aromatic naphthenes in the lubricating oil boiling range have F factors below 8. It has also been observed that the fractions having F factors or a value below 8 have high viscosity indexes while those fractions having F factors or a value above 8 have low viscosity indexes.

It has been found that lubricating oil may be separated by silica gel percolation into about 5 fractions having widely different viscosity index characteristics. These various fractions each consist of a large number of compounds of a certain type. Silica gel percolation separates as a first fraction of lubricating oil a paraffinic-naphthene fraction containing from 1 to 3 naphthene rings, aromatic-naphthenes containing on the average 1 aromatic and 1 naphthenic ring, and condensed naphthenes containing 2 or more naphthene rings, naphthalenes containing 2 or more aromatic rings of which only 2 are condensed and higher condensed aromatics containing 3 or more aromatic rings of which at least 3 are condensed.

The paraffinic naphthenes may be considered as paraffinic and naphthenic fractions, whereas the aromatic naphthenes may be considered as single ring aromatic fractions which have a naphthenic ring attached thereto, as described in Patent 2,643,217, where identical compounds are described.

When F factors or values for these various compound types are obtained from lubricating oil, for example, by silica gel percolation thereof, the compounds are separated largely as shown in Table 1.

TABLE 1

Compound Type	F
Paraffinic Naphthenes	−4 to +6
Condensed Napthenes	8 to 10
Aromatic Naphthenes	2 to 6
Naphthalenes	10 to 20
Higher Condensed Aromatics	Greater than 40.

The F value to be employed to characterize the various components in a lubricating oil fraction for a particular stock may be determined by assuming a constant molecular weight for the lubricating oil fraction for which the value is to be obtained. Since the molecular weights of the narrow fractions secured by silica gel percolation of the lubricating oil fraction have a maximum variation of about 10%, the F factor may have a maximum variation of about 10% due to the molecular weight change.

The paraffinic-naphthenes and aromatic-naphthenes forming the composition of the present invention may be blended together in any ratio to give the desired viscosity index.

However, since both the paraffinic-naphthenes and the aromatic naphthenes have high viscosity indexes as compared to the low viscosity indexes

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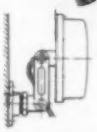

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of the other components of the lubricating oil, it will be desirable to utilize all of the aromatic-naphthenes with the paraffinic-naphthenes obtainable from a given lubricating oil fraction.

It has been determined that the paraffinic-naphthenes and aromatic-naphthenes are present in lubricating oil fractions from the Panhandle field in Texas and from the Texas Coastal crudes in the approximate ratio of 7 parts by volume of paraffinic-naphthene. While this is the preferred ratio, greater amounts of the paraffinic naphthenes may be used depending on the viscosity index of the particular aromatic-naphthene secured from a particular lubricating oil.

In order to illustrate the invention further, lubricating oil fractions obtained from Panhandle crude from the Panhandle field in Texas and from Texas Coastal crudes were subjected to contact with a column of silica gel. The lubricating oil fractions from the Panhandle crude were a dewaxed medium motor oil distillate and a finished Bright Stock. The dewaxed motor oil distillate on percolation through the column of silica gel gave the results shown in Table 2.

TABLE 2

Crude Source	Panhandle Dewaxed Medium Motor Oil Distillate	
Sample Compound Class	Vol. %	V. I.
Paraffinic-Naphthenes	60	124
Condensed Naphthenes	10	47
Aromatic Naphthenes	8	97
Naphthalenes	12	38
Higher Condensed Aromatics	10	—81

The data in Table 2 show the percentage and the viscosity index of the various fractions. It will be noted that the paraffinic-naphthenes have a viscosity index of 124 whereas the condensed naphthenes have a viscosity index of only 47. On the other hand, the aromatic-naphthenes have a viscosity index of 97. Both of these fractions, therefore, are suitable for blending together to form the composition of the present invention. It will be noted that the ratio of paraffinic naphthenes to aromatic naphthenes is 7½:1; consequently it is desirable to blend the paraffinic naphthenes with the aromatic naphthenes in this ratio to obtain maximum yields.

The paraffinic-naphthenes in Table 2 contain 1 to 3 naphthene rings. The condensed naphthenes contain 3 or more rings, at least 2 of which are condensed, while the aromatic naphthenes contain on the average 1 naphthene ring and 1 aromatic ring.

A finished Bright Stock from Panhandle crude was also percolated through a silica gel column and was found to contain 60% by volume of paraffinic-naphthene having a viscosity index of 109. The Bright Stock also contained 8% by volume of naphthenes having a viscosity index of 97. These fractions may also be blended to obtain a composition in accordance with the present invention.

A medium motor oil distillate from a Texas Coastal crude was also percolated through a silica gel column and was found to contain 57% by volume of paraffinic naphthenes and 7% by volume of aromatic naphthenes, the paraffinic-naphthenes had a viscosity index of 102 while that of the aromatic naphthenes was somewhat lower. In this particular instance, it will be noted that the ratio of paraffinic naphthenes to aromatic naphthenes is not quite 7½ : 1. It will be desirable, therefore, to blend the paraffinic-naphthenes and the aromatic-naphthenes in this particular ratio.

It has been mentioned that the composition of the patent may be obtained by percolating a lubricating oil fraction through silica gel and blending the segregated fractions. The segregation of a lubricating oil fraction into components of varying viscosity index characteristics by means of silica gel may be carried out on a batch or continuous basis. The optimum ratio of hydrocarbon oil to silica gel for a batch operation is well known, a value of 1 : 10 by volume being typical. The silica gel is charged into a column whose ratio of diameter to length is governed by the degree of separation desired. For the type of separation described in this memorandum, a ratio of diameter to length of 1 : 300 is preferred.

The temperature at which the percolation is conducted may be a temperature in the range of about 60 to about 150° F. A temperature of 80° F. will give quite a satisfactory result, if the viscosity of the oil is reduced by dilution with a light paraffinic solvent, such as normal heptane.

The segregation of a lubricating oil fraction into fractions of varying viscosity index characteristics and recombination of certain fractions to obtain an oil of improved viscosity index is illustrated in Fig. 1. Column 10 is filled with silica gel.

The quantity of oil, which is optimum for the amount of silica gel placed in column 10, is withdrawn from hydrocarbon charge tank 11 and discharged into charge blending tank 15. After valve 14 is closed, paraffinic solvent is withdrawn from tank 16 through line 18 until the desired ratio of paraffin solvent to oil for control of

the viscosity of the mixture is obtained. Valve 19 is then closed and connected to controller 20 which keeps it in a closed position until activated by liquid level control 21.

After the hydrocarbon and paraffin solvent have been thoroughly mixed by mixer 22, the charge passes from the blending tank into the silica gel column. As the mixture of hydrocarbon and paraffin solvent passes through the silica gel, it is separated into various fractions, depending upon the affinity of the silica gel for the various compound types.

The order of increasing affinity of silica gel for the various compound types is: paraffinic-naphthenes, condensed naphthenes, aromatic-naphthenes, naphthalenes, and higher condensed aromatics.

If both the condensed aromatic compound types are contained in the charge, both are held strongly by the silica gel in the presence of paraffinic solvent under the condition being described. The effluent from the silica gel column is pumped into fractionating column 29. This column causes a separation between the hydrocarbon and the paraffinic solvent admixed with it.

The paraffinic solvent is taken as overhead through line 30 and pumped into storage tank 16. The hydrocarbon is withdrawn as bottoms through line 31 and all, or a portion of it, passes through a refractive index indicating recording device (32).

The signal from the refractive index indicator is transmitted through line 33 into recorder 34 which converts it into an *F* value. The recorder (34) is adjusted for the molecular weight of the lubricating oil being percolated in column 10.

Since the molecular weight of the particular narrow lubricating oil fraction recovered from column 10 will not vary greatly, the *F* value will not be effected substantially by any slight variation thereof.

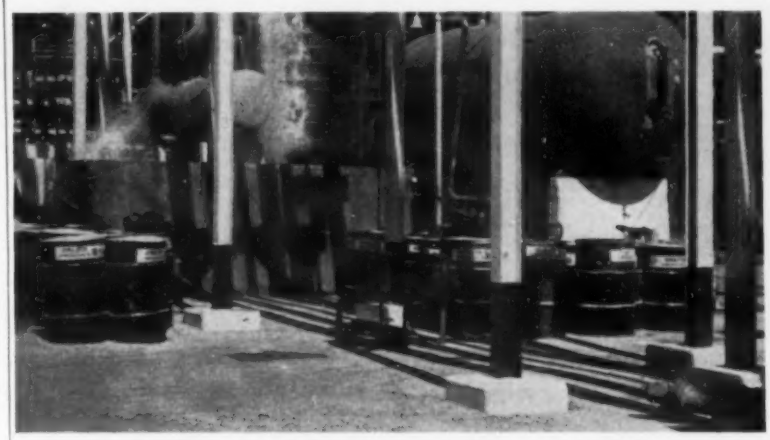
If the *F* value is 8 or greater, a signal is transmitted through line 35 to valve 36 causing it to open and through line 40 to valve 41 causing it to close; the material is discharged through line 37 and pump 38 into tank 39 which contains the lower viscosity index fractions.

If the *F* factor is less than 8, a signal is transmitted through line 40 to open valve 41 and through line 35 to close valve 36. Thus, material for which *F* is less than 8 is passed into tank 42 through line 43. This tank 42 contains the higher viscosity index components of the lubricating oil fraction.

When the charge contained in the charge blending tank 15 is depleted, liquid level control 21 causes valve 20 to be opened and a paraffinic solvent is pumped through the charge blending tank into the silica gel column 10. This solvent flushes remaining materials for which silica gel does not have a relatively strong affinity from column 10 into fractionator 29.

When the paraffinic solvent no longer desorbs appreciable quantities of material from the silica gel in column 10, the liquid level in column 29 decreases and causes liquid level control 44 to close valve 23, open valve 24A, close valve 25, and open valve 26.

When the valves are positioned in this manner, a polar solvent such as benzene or alcohol is withdrawn from tank 45 and forced into silica gel column 10 by pump 46 to cause the material remaining adsorbed on the silica gel to be desorbed and pass out of the column 10 through line 27 and valve 26 and be pumped into fractionator 47



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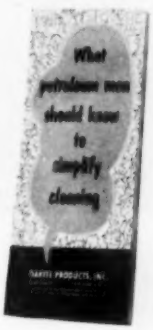

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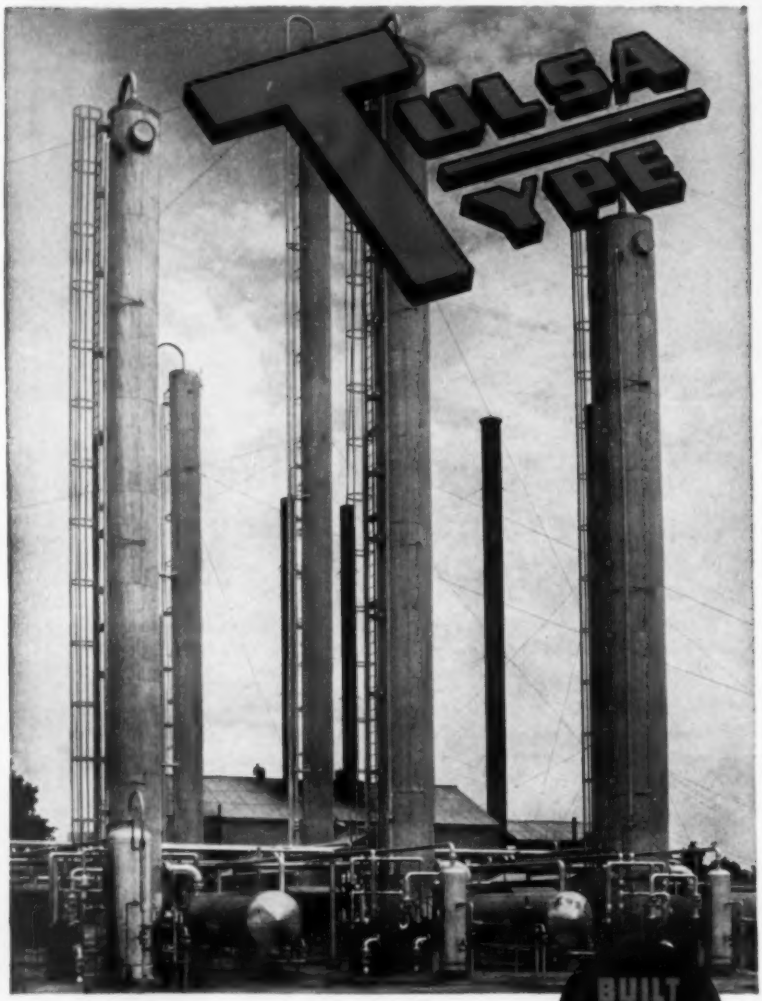
which effects a separation between the polar solvent and the material which it has desorbed.

When desorbing the silica gel in column 10 with a polar solvent, the output of the column 10 does not pass through a refractive index determining device because it has been found that all hydrocarbons that have to be desorbed from silica gel by using a polar solvent have *F* factors considerably greater than 10 or 15. Therefore, all of the material desorbed by the polar solvent will have undesirable lower viscosity index characteristics.

When the silica gel in column 10 has been completely desorbed as indicated by liquid level indicator 48, all valves are closed and the silica gel is regenerated. This regeneration may be carried out in the silica gel column 10 by any one of several methods such as by blowing with steam or hot air.

It will be seen that two components of the lubricating oil of the present invention may suitably be obtained by silica gel extraction. The lubricating oil may be separated into paraffinic-naphthenes and into aromatic-naphthenes by extraction with solvents but this may be a tedious, time-consuming operation.



TULSA TYPE Deethanizer, Depropanizer and Debutanizer Columns in natural gasoline plant.

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Patents Issued in May

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for May 4, 11, 18, and 25, 1954, Vol. 682, Nos. 1-4.

PROCESSES

Refining

2,677,648 (Standard Oil Co.-Ind.) Desulfurization of high sulfur olefinic naphtha with hydrogen fluoride-activated alumina.
2,678,111 (Standard Oil Development Co.) Fluidized adsorption process for separation of gaseous components.
2,678,199-201 (Koch Engineering Co., Inc.) Gas-liquid contact apparatus.
2,678,699 (Superior Tank & Construction Co.) Oil and gas separator.
2,678,954 (Phillips Petroleum Co.) Removal of fluorine from hydrocarbon oils by treatment with boric oxide or boric acid.
2,679,470 (Shell Development Co.) Process and apparatus for continuously treating a fluid with an immiscible liquid.
2,679,471 (Pure Oil Co.) Process for refining lubricating oils to zero acid number by treatment with clay followed by zirconia.
2,679,472 (Phillips Petroleum Co.) Separation of dimethyl pentanes and cyclohexane azeotropic distillation with acetonitrile.
2,679,484-8 (Petrolite Corp.) Process for breaking petroleum emulsions.
2,679,507 (Standard Oil Co.-Ohio) Disposal of spent refinery caustic waste by adding ferrous salt to precipitate sulfur compounds.
2,679,536 (Standard Oil Co.-Ohio) Disposal of spent refinery caustic waste by adding ferrous iron to precipitate sulfur compounds.
2,679,537 (Standard Oil Co.-Ohio) Disposal of waste caustic solution by treatment with spent pickle liquor by adding spent pickle liquor.

Conversions

2,677,604 (Standard Oil Development Co.) Contacting solids and fluids in dense turbulent mass.
2,677,649 (Standard Oil Development Co.) Process and catalysts for petroleum reforming (Zn O-ammonia-Cr_2O_3).
2,677,650 (Pittsburgh Consolidation Coal Co.) Carbonization of agglomerative coals.
2,678,339 (Wulff Process Co.) Process of producing gases by pyrolysis.
2,678,874 (Houdry Process Corp.) Gas distributing and collecting channels for reaction vessels.
2,678,904 (Standard Oil Development Co.) Olefin polymerization process.
2,678,923 (Socony-Vacuum Oil Co., Inc.) Reforming catalyst (chromia-fluorine-alumina).
2,678,956 (Koppers Company, Inc.) Acetylene and ethylene by thermal cracking of hydrocarbons.

PRODUCTS

Chemicals

2,677,617 (Universal Oil Products Co.) Stabilization of organic compounds with organic sulfur compounds.
2,677,678 (Shell Development Co.) Unsaturated benzoic acid (copolymer) derivatives.
2,677,702 (Universal Oil Products Co.) Hydrocarbon copolymer sulfonic acid derivatives as emulsifiers, etc.
2,677,703 (California Research Corp.) Production of bibenzyl dicarboxylic acids by reacting toluic acid and sulfur.
2,678,332 (Standard Oil Development Co.) Esterification of olefins using ion exchange resins catalysts.
2,678,333 (Socony-Vacuum Oil Co., Inc.) Aminomethylsulfonic acid in the Mannich and related reactions.

(To obtain more data on advertised products see page 1112)

2,678,337 (Shell Development Co.-Calif.) Catalytic isomerization of methyl substituted phenols, using HF-treated alumina catalyst.
2,678,338 (Universal Oil Products Co.) Production of cyclohexadiene by reacting cyclohexanone and cyclohexanol with acid acting catalyst.
2,678,941 (California Research Corp.) Production of aromatic dinitriles from isophthalic acid.
2,678,942 (California Research Corp.) Producton of cyano-aromatic carboxylic acids.
2,678,947 (Phillips Petroleum Co.) Preparation of alpha-haloalkyl-benzene sulfonates.
2,678,951 (Shell Development Co.) 2,3,5 trimethyl phenol from 3,5 xylenol and methanol.
2,678,952 (Standard Oil Development Co.) Process for reducing sulfur content of oxo alcohols with aldehyde.
2,678,957 (Socony-Vacuum Oil Co.) Polymerization of monoalkylethylenes using Al bromohalide catalyst.
2,679,497 (Phillips Petroleum Co.) Treatment of rosin soaps and use of treated rosin soaps in emulsion polymerization.
2,679,534 (Standard Oil Development Co.) Decobalting oxo aldehyde product in the presence of liquid water.
2,679,535 (California Research Corp.) Purification of phenol.
2,679,539 (Phillips Petroleum Co.) Separation of hydrocarbon eutectic-forming mixtures by crystallization.
2,679,540-3 (Union Oil Co. of Calif.) Process and apparatus for acetylene production by partial oxidation of hydrocarbons.
2,679,544 (Union Oil Co. of Calif.) Manufacture of acetylene and mixtures of acetylene and hydrogen cyanide (reacting oxygen, ammonia and hydrocarbon.)

Fuels

2,677,235 (Power Jets) Gas turbine power plant for utilizing solid water-bearing fuel.
2,678,262 (Gulf Research & Development Co.) Stable fuel oil compositions containing dialkyl dithiophosphoric acid salt as sludge inhibitor.
2,678,907 (Du Pont Co.) Controlling the flow of tetraethyl lead reaction masses.

Lubricants

2,677,659-60 (Socony-Vacuum Oil Co.) Oil composition of improved pour stability, containing metalsalt of acid containing wax-substituted aryl nucleus.
2,677,661 (Standard Oil Development Co.) Bentonite greases.
2,677,662 (Standard Oil Development Co.) Lubricating oil additives (copolymer of maleic anhydride and vinyl alkyl ether).
2,678,301 (Tide Water Associated Oil Co.) Method of preparing an alkaline concentrate of mahogany sulfonates for diesel lubricating oils.
2,678,918 (Shell Development Co.) Production of anhydrous soda base lubricating greases.
2,678,919 (Standard Oil Development Co.) Lubricating oil containing alkyl itaconate copolymer as pour depressor.
2,679,479 (Shell Development Co.) Inorganic gelling agent thickened fluorocarbon grease compositions.
2,679,480 (Standard Oil Co.-Ind.) Indogen thickened grease composition.
2,679,481 (Socony-Vacuum Oil Co., Inc.) Nitrogen ring antioxidants in solvent refined steam turbine lubricating oil.

Specialties

2,677,151 (Socony-Vacuum Oil Co., Inc.) Method of casting wax slabs.
2,677,152 (Socony-Vacuum Oil Co., Inc.) Slabbing of microcrystalline wax.
2,677,618 (Standard Oil Co.-Ind.) Rust preventive compositions containing sulfonate and morpholine soap.
2,677,620 (Standard Oil Co.-Ind.) Bituminous composition containing P-S compound.
2,678,920 (Gulf Research & Development Co.) Flushing compositions containing isopropyl phenol, oil, soap and water.
2,679,533 (California Research Corp.) Addition products of halogen and quaternary ammonium germicides and method for making the same.

EQUIPMENT

Processing, general

2,677,435 (Laurance S. Reid) Gas contactor.
2,677,531 (Alvin Hock, Sr., and Max Leva) Built-up, plate type heat exchanger having spiral flow.
2,678,108 (Laurance S. Reid) Apparatus for flowing gas through a permeable adsorbent bed.
2,678,199 (Koch Engineering Co.) Gas-liquid contact apparatus.
2,678,200 (Koch Engineering Co.) Apparatus for effecting intimate contact between liquids and gases.
2,678,201 (Koch Engineering Co.) Gas-liquid contacting apparatus.
2,678,812 (Phillips Petroleum Co.) Pebble heater apparatus.
2,679,208 (Interchemical Corp.) Proportioning device.
2,679,470 (Shell Development Co.) Process and apparatus for continuously treating a fluid with an immiscible liquid.
2,679,540 (Union Oil Co. of Calif.) Apparatus for acetylene production.
2,679,541 (Union Oil Co. of Calif.) Apparatus for acetylene production.

Catalytic Reactors

2,677,579 (Sun Oil Co.) Air lift engager apparatus.
2,677,602 (Houdry Process Corp.) Integrated channels and gratings.
2,678,874 (Houdry Process Corp.) Gas distributing and collecting channels for reaction vessels.

Instruments

2,677,271 (Standard Oil-Ohio) Apparatus for testing materials having plastic flow characteristics.
2,677,276 (Cutler-Hammer, Inc.) Liquid level and temperature indicating apparatus.
2,677,303 (Bowser, Inc.) Oil tester.
2,677,480 (Sol B. Wiczer) Combination volumetric burette.
2,677,816 (Sun Oil Co.) Floating roof tank warning device.
2,677,964 (George H. Ennis and Robert V. Funk) Fluid level-indicating and controlling device.
2,678,431 (Standard Oil Development Co.) Control panel display system.
2,678,434 (Reliance Gauge Column Co.) Electrically operated boiler alarm control device.
2,678,986 (British Insulated Callender's Cables, Ltd.) Vacuum gage of Pirani type.
2,679,157 (Phillips Petroleum Co.) Viscosimeter.
2,679,640 (John Dondero and Herbert Fochs) Remote valve control and position indicator system.
2,679,642 (Westinghouse Electric Corp.) Liquid level indicator.

Pumps & Compressors

2,677,327 (A. Y. McDonald Mfg. Co.) Centrifugal pump construction.
2,677,328 (General Electric Co.) Centrifugal pump for high-temperature liquids.
2,678,005 (Frank G. Campbell) High-pressure pump.
2,678,606 (Worthington Corp.) Centrifugal pump or compressor.
2,679,211 (Hallvard Naess) Variable output pump.

Valves & Fittings

2,678,066 (J. C. Carter Co.) Fluid flow control device.
2,678,623 (Victor E. Rainsford) Transparent test plug for steam traps.
2,678,799 (Phillips Petroleum Co.) Quick closing valve.
2,678,801 (Hays Mfg. Co.) Tamperproof plug valve.
2,678,802 (Fairbanks Co.) Seat ring means for portways of gate valves.

Miscellaneous

2,677,271 (Standard Oil Co.-Ohio) Apparatus for testing materials having plastic flow characteristics.
2,677,668-9 (U.S.A.-Atomic Energy Commission) Stabilization of reduced pyrophoric metal catalyst.
2,678,133 (Sun Oil Co.) Continuous filter.
2,678,264 (Standard Oil Development Co.) Production of industrial gases containing carbon monoxide and hydrogen.
2,678,911 (California Research Corp.) Emulsion testing.
2,679,157 (Phillips Petroleum Co.) Viscosimeter.

How to Obtain Patents

Readers may obtain copies of any U.S. patent from the Patent Office at 25¢ each. Order by patent number direct from The Commissioner of Patents, Washington 25, D.C.

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You can cut off 8" pipe, *in*

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Without obligation, please send me descriptive literature on your new hinged pipe cutters.

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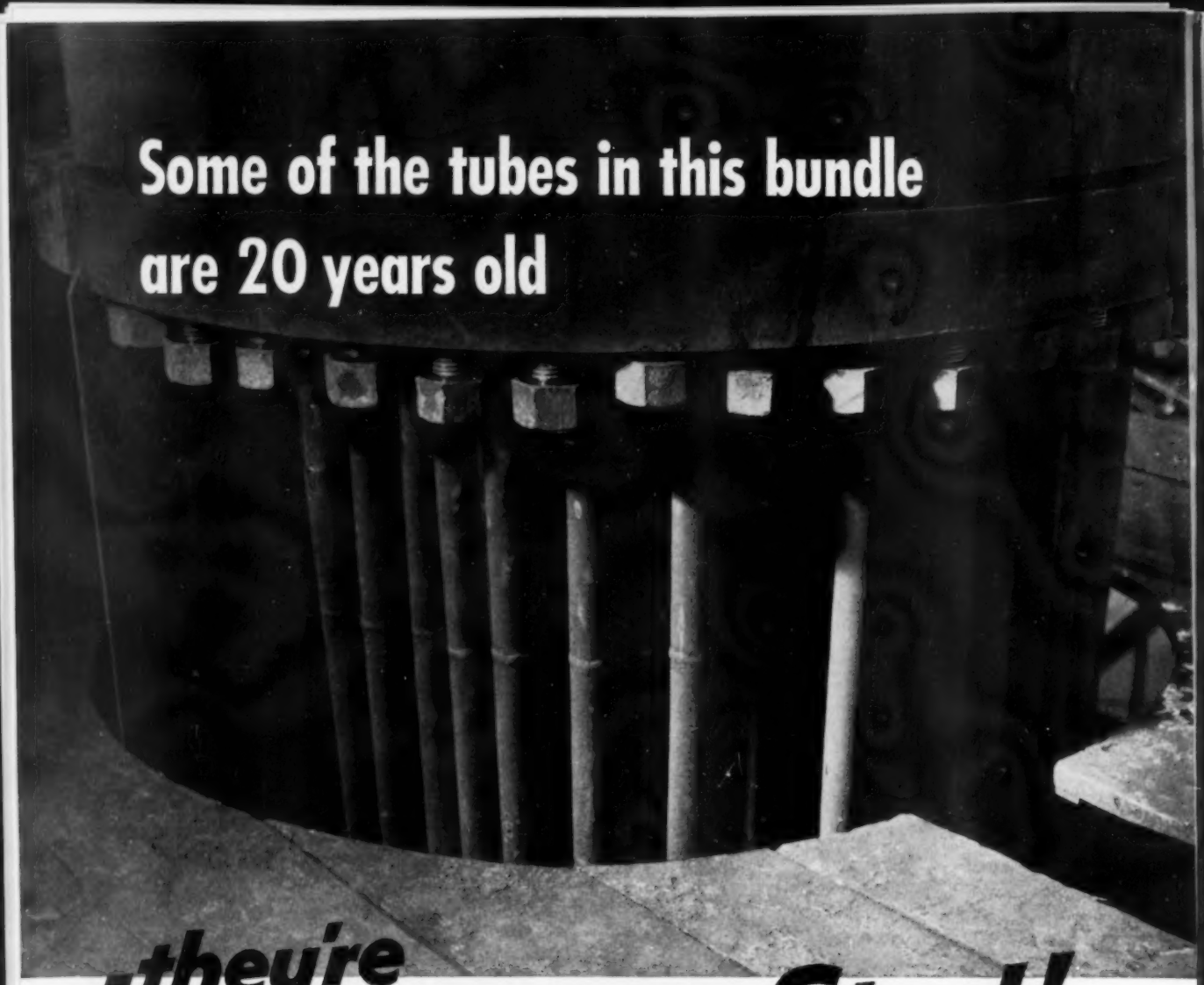

Some of the tubes in this bundle are 20 years old

...they're Stainless Steel!

This particular bundle of heat exchanger tubes is from a Thermal Cracking Unit at a major southwestern oil refinery. Some of these tubes have been handling a variety of corrosive products for more than 20 years. Yet, because they are Stainless Steel, they still get the inspector's "OK."

Stainless Steel's resistance to corrosive media frequently found in the oil made it a logical selection for this job. Its non-fouling tendencies have permitted longer runs, increased throughput, increased yields and decreased downtime.

The durability of these Stainless Steel tubes is proved by the fact that they have been removed, straightened and reinstalled. Some have been lengthened by heliarc welding on short lengths.

This is but one of many examples of the economy of using Stainless Steel in refinery operations. Its excellent corrosion and temperature characteristics, plus the freedom it gives from contamination, make it invaluable in keeping your refinery on stream.

Take advantage of the properties of Stainless Steel, and when you do, be sure it is perfected, service-tested USS Stainless Steel. For extensive data on the performance of Stainless Steels in refinery service, write for our 44-page book. Send your request to United States Steel Corporation, Room 4381, 525 William Penn Place, Pittsburgh 30, Pa.

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USS

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SPECIAL SECTIONS

4-1292

UNITED STATES STEEL

Mr. Kenney

Mr. Henna

Bryant F. Kenney has been made a director of the Standard-Vacuum Oil Co. and has returned to the New York office after three years as chairman and managing director of the subsidiary, Standard-Vacuum Refining Co. of South Africa, Ltd. The subsidiary recently opened a fuel products refinery at Durban, Union of South Africa.

The new managing director of the South African company is **John B. Henna,** who was formerly of Mountainside, N. J.

Dr. W. Smith Dorsey has been appointed research supervisor in charge of all problems relating to petrochemicals in Union Oil of California's research and process department.

Dr. C. E. Wilson and **F. S. Scott** have been given the newly created title of senior research associate, originated in order to denote outstanding personal achievement.

Dr. Henry H. Storch, formerly chief of the synthetic fuels branch of the Bureau of Mines, has been employed by the Stamford, Conn., research laboratories of American Cyanamid Co., New York. He has become a technical assistant to the director of the laboratories and other branches of the research division of the company, especially in the field of coal and gas technology, and of catalysis.

Dr. Storch joined the Bureau of Mines in 1928, and in 1930 became chief physical chemist at its Pittsburgh, Pa., laboratories. Since that time he has been concerned with many scientific and administrative phases of the bureau's work on synthetic fuels.

Walter T. Jameson has been designated superintendent of the heavy crude refinery Union Oil Co. has announced that it will build near Santa Maria, Calif. A graduate of Stanford University and Massachusetts Institute of Technology, Mr. Jameson has served the company at its Oleum, Calif., Cut Bank, Mont., and Los Angeles refineries. Most recently, he has been assistant superintendent of operations at the last-named plant.

Ernest B. Miller, Jr., has been named vice-president in charge of Tide Water Associated Oil Co.'s southern division. Mr. Miller has been with the company for 20 years, and until 1947, when he became chief petroleum engineer, was chief production engineer and district petroleum engineer.

Bruce Jones, manager of the Panhandle Oil Corp.'s refinery at Wichita Falls, Texas, has been elected a vice-president of the company. Mr. Jones began with Panhandle in 1952, coming to the company after five years as chief project engineer with the Votator Division of the Girdler Corp. He had served The Texas Co. in several technical capacities before that time. In his new position Mr. Bruce will continue to manage the Wichita Falls refinery.

Jan G. Schaafsma has been promoted to assistant manager for the laboratories department of General Petroleum Corp. Mr. Schaafsma joined the company in 1934 upon receiving his master's degree from the California Institute of Technology. He was first employed as a junior inspector, and was assistant to the manager of the laboratories from 1947 until his latest promotion. Mr. Schaafsma is the inventor of a patented treating process for petroleum.

Mr. Schaafsma

William W. Keeler, Phillips Petroleum Co., has been chosen chairman of the recently reactivated Military Petroleum Advisory Board. The board also named chairmen to head five panels. **A. C. Rubel,** Union Oil Co., is chairman of the production panel; **C. E. Davis,** Shell Oil Co., the refining panel; **Richard E. Nelson, Jr.,** Standard Oil Co. of Indiana, the transportation panel; **S. F. Coleman,** Standard Oil of New Jersey, the program panel; and **Elmer Batzell,** attorney, the panel on materials.

P. R. Wrigley has been appointed to the industrial relations department of the Western Petroleum Refiners Association. He succeeds J. R. Upton.

Mr. Wrigley earned his B.A. degree in business administration from the University of Oklahoma. He was formerly employed by the Rock Island Railroad and is a veteran of both World War II and the Korean War.

Stanley B. Crooks, Bartlesville, superintendent of sales and traffic for Cities Service Oil Co., has been awarded the distinguished service medal of the Natural Gasoline Association of America. The medal is a citation for Mr. Crooks' 33 years as a charter member of the association and his contributions to the industry in the field of committee work in traffic, technical and statistical studies. Mr. Crooks works for the gasoline-chemical division of the Cities Service company.

Mr. Crooks

Robert H. Colley, chairman of the board of the Atlantic Refining Co. since 1952, has retired from the company. He is continuing his membership on the board.

Mr. Colley, who started with Atlantic in 1919, has been connected with the oil industry for more than 48 years. In 1926 he was made assistant treasurer of the company, and became treasurer and a director in 1929. He was elevated to the presidency in 1937 and guided the company through the war years and the expansion that followed until he was succeeded as president by Henderson Supplee, Jr., in 1952. At that time he was elected chairman of the board.

For many years he was a director and member of the executive committee of the American Petroleum Institute, and at its annual meeting in 1953 he was elected an honorary life director.

Gordon P. Larson, director of the Los Angeles county, Calif., air pollution control district, has been elected president of the Air Pollution Control Association. Mr. Larson, whose work with the district led to the first identification of gasoline vapors as an air contaminant, served as the first vice-president of the Association during the past year and has been one of the nine directors for the past two years.

He has been director of the district since 1949, having joined it at its inception in 1948. Before that he was a

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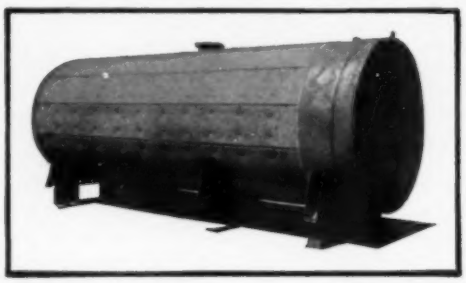
Imagine wrapping tanks and towers with a lightweight, flexible insulation that fits any curved or flat surface — instead of laboriously building up rigid insulating materials, block by block. Imagine further that the new method requires almost no cutting or fitting time, no expansion joints or welded rings, no pointing up.

Then imagine how much time and money this method would save you — and at once you'll see the advantages of using ULTRALITE long glass fiber insulation blankets. It is easily applied and easily finished with weatherproofing materials. Savings are truly worthwhile, as proved time and again on oil storage tanks, asphalt truck tanks, fractionating columns, reboilers, blending tanks, etc. (And for hot or cold piping, savings are just as substantial when you use our new G-B Snap-On pipe insulation — a one-piece molded pipe insulation of fine glass fibers.)



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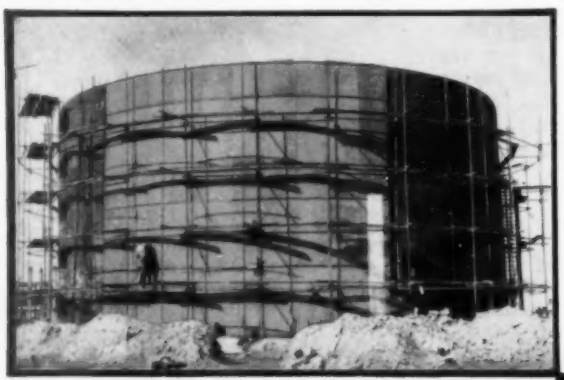

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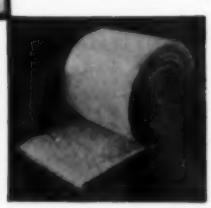

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commissioned officer in the U. S. Army Corps of Engineers for 12 years, retiring as a Lieutenant Colonel. Mr. Larson was graduated from the U. S. Military Academy at West Point in 1933.

M. T. McCants will be the plant manager for the new refinery to be constructed by the Great Northern Oil Co. at Pine Bend, Minn. The refinery is expected to be completed late in 1955 and will have an initial capacity of 20,000 bbls. / day. Mr. McCants will be in charge of the construction and technical development of the plant.

Mr. McCants

Mr. McCants' education was at Rice Institute, Houston, and Massachusetts Institute of Technology, where he was awarded an M.S. in 1940. His first job in the industry was as a chemical engineer at the Humble Oil Co.'s Baytown, Texas, refinery. His other positions have been with the Great Southern Corp., Corpus Christi, as a plant chemical engineer, and the Fluor Corp., Ltd., as a process and project engineer.

He comes to his new position from Corpus Christi, where he has been associated with the Great Southern Chemical Corp. as general plant superintendent since 1951.

James N. Gorringe has been appointed coordinator of management development of Esso Standard Oil Co. He succeeds Owen W. Humphrey, who has retired.

Mr. Gorringe has been employee relations manager of three of the company's plants and most recently was assistant process superintendent at the Bayonne, N. J., refinery.

J. E. Roth has been appointed general manager of the newly organized central division of Tide Water Associated Oil Co. The reorganization affects the company's mid-continent operations, which are now grouped into two divisions—central, with headquarters at Tulsa, Okla., and southern, at Houston, Texas. Mr. Roth's division includes Illinois; Kansas; New Mexico; Oklahoma; Pennsylvania; north, central and west Texas; the Rocky Mountain area; and western Canada.

General manager of the southern division is **E. B. Miller, Jr.**, who has as his responsibility operations in Ala-

(To obtain more data on advertised products see page 1112)

bama; Arkansas; Florida; Louisiana; Mississippi; and parts of Texas not within the central division.

Lloyd Armstrong, Houston, has been appointed assistant general manager of the southern division.

W. Ward Jackson has been named a vice-president of Commercial Solvents Corp., succeeding **Abbott K. Hamilton,** who has resigned. Mr. Jackson, formerly general manager of the company's industrial chemicals sales department, directs the petrochemicals division in his new capacity.

Mr. Jackson

For 22 years, prior to joining Commercial Solvents in 1951, he held sales and executive positions in the chemical industry.

During World War II he served in an advisory capacity to the War Production Board and as a consultant to its chemical bureau, aircraft production board, and facilities bureau. Since the war he has been a chemical consultant to the chemical division of the National Production Authority.

M. M. McCallen, president of McCallen Refining Co., has been elected president of the Independent Refiners Assn. of California, succeeding **C. A. Johnson,** chairman of the board of Socal Oil and Refining Co., who served the last two terms.

Other officers: **Newcomb D. Taylor,** sales manager of Hancock Oil Co., vice-president; **Malcolm McDuffie,** production vice-president of Mohawk Petroleum Corp., secretary-treasurer, and **Don B. O'Neill,** executive vice-president.

Newly elected directors are Mr. McDuffie and **D. S. Fletcher,** president of Fletcher Oil Co., replacing **W. G. Krieger,** president of Douglas Oil of California, and **E. O. Bachman,** Century Oil, who have served 3-year terms. The other five directors are: **A. M. Lockhart,** president of Envoy Petroleum Co.; **S. V. Millington,** sales manager of Triangle Oil & Refining Co.; Mr. Johnson, Mr. McCallen and Mr. Taylor.

Harold G. Osborn, vice-president for manufacturing of Continental Oil Co., has been elected to the company's board of directors.

Mr. Osborn has been with the company since 1921. He was made assistant superintendent of the Ponca City refinery in 1926 and became assistant manager of manufacturing the following year. In 1935 he was promoted manager of the manufacturing department. He was elected to the vice-president's post of the department in 1946. His home town is Watertown, N.Y., and he attended Kalamazoo College, Kalamazoo, Mich.

R. R. Davis has been appointed assistant manager of the process materials division of Sinclair Refining Co. He was formerly a section chief on the staff of the Sinclair Research Laboratories, Inc., Harvey, Ill.

Robert L. Greene, formerly process engineer with the Esso Engineering Department of Standard Oil Development Co., has joined the staff of Purvin and Gertz, consulting engineers of Dallas, Texas, as a process consultant in the design and operation of facilities for the processing of oil and gas.

R. W. Cretney has been named vice-president and general manager of the Thermatomic Carbon Co., succeeding **Clark Boardman,** who has retired after 32 years with the firm.

S. S. Gill has been named manager of Thermatomic's Sterlington, La., plant. He previously was the company's plant engineer.

L. V. Steck, marketing vice-president of Shell Chemical Corp., New York, has been given the annual award of the Commercial Chemical Development Association for outstanding accomplishment in this field.

Mr. Steck has been in the chemical field for 30 years. From 1924 to 1930 he was a chemical engineer for Pike & West in Emeryville, Calif. He joined Shell Development Co. in 1930 as manager of the company's market development organization. In 1941 he became affiliated with Shell Chemical and the following year was appointed vice-president in charge of marketing.

One of his earliest chemical achievements was the market development of ketones for use as lacquer solvents, bringing methyl ethyl ketone from the test tube to its current multi-million gallon sales volume.

Throughout his years with both Shell companies, Mr. Steck was active in the development of chemicals derived from propylene. Research in this field led to the first synthetic glycerin, the marketing of which was largely under Mr. Steck's direction.

Another move strongly supported

what's NEW in Engineering

A new free-hand electric bandsaw is said to cut through metals "like a knife through butter". It is light enough (16 pounds) to be used free-hand in any position, and the power driven unit is claimed to be the first completely portable unit of its kind. Slightly larger than a hand hacksaw, it is about 15 times faster.

On Puget Sound at Steilacoom, Kaiser Engineers designed and recently completed one of the nation's most modern aggregates plants to supply the growing demand for sand and gravel in the Pacific Northwest. A unique feature of the plant's

construction was the erection of serpentine walls in the sand and gravel storage areas to eliminate dead space. The new plant's flexibility of operation is such that it not only can handle most common sizes of gravel, but also any other specific sizes ordered by customers. Its crushing and screening capacity is 375-500 tons per hour.

Conditioning of Water for Industrial Use is the title of a new book, written by Sheppard T. Powell being published by McGraw-Hill this month.

This modern guide to water conditioning describes the various types of apparatus in detail, including design features, control required for efficient performance, cost of installation and operation and other pertinent information.

Whether it's designing an oil refinery, building a manufacturing plant or laying out a plant site, Kaiser Engineers undertakes the job with assurance because of the variety of talent within the organization. Successful experience in a wide field of design, engineering and construction tells the story. Call or write: Kaiser Engineers, Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

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IDEAL
WIEDEKE Precision-Built Tube Expanders
No. 255 for average Sheets
Ball Bearing Adjustable Thrust Collar Tube Expanders are made for Tubes ¼" diameter and larger.
Recommended for use with any Controlled Rolling Motor for uniform expansion of Tubes.
See your Dealer or write us for Bulletin.
For Rolling—Heat Exchanger, Condenser and other Heat-Transfer Tubes.
No. 270—For thick or multiple Sheets.
THE GUSTAV WIEDEKE COMPANY
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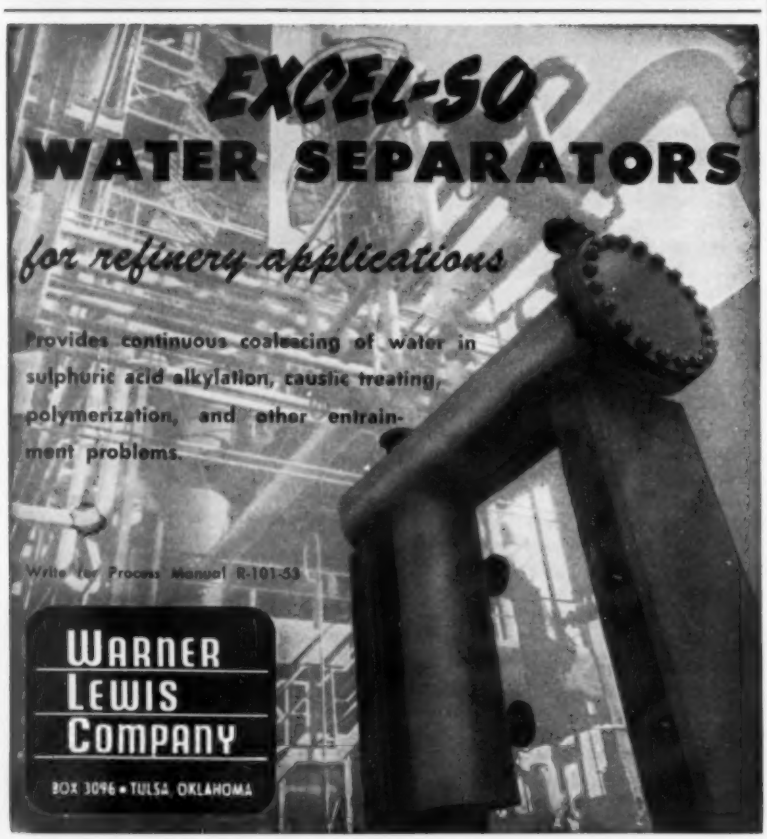
EXCEL-SO
WATER SEPARATORS
for refinery applications
Provides continuous coalescing of water in sulphuric acid alkylation, caustic treating, polymerization, and other entrainment problems.
Write for Process Manual R-101-53
WARNER LEWIS COMPANY
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by Mr. Steck was the company's production on a large scale of allyl chloride, which made possible the manufacture of epoxy resins on an economical basis.

F. E. Caddy, Shell Chemical Corp. plant manager at Martinez, Calif., has been named manager of the company's new plant at Norco, La. His position at the Martinez works has been taken by **Ernest W. Casagrande,** formerly plant superintendent of the Shell Chemical ammonia plant at Pittsburg, Calif.

Leaving the head office of the company's manufacturing department, at New York, is **C. H. Plomteaux,** who will be Mr. Caddy's assistant superintendent at Norco.

Mr. Caddy joined Shell in 1931 at Pittsburg, Calif., and served also at Dominguez and Torrance in California while advancing through the ranks of the company. He was appointed plant superintendent at Houston, Texas, in 1948 and became plant manager at Martinez in 1951.

Mr. Casagrande joined the Shell organization in 1934 at the Martinez refinery. After transferring to the operating department of the Martinez chemical plant he began a series of promotions that led him to the post of plant superintendent at Pittsburg, Calif., in 1951.

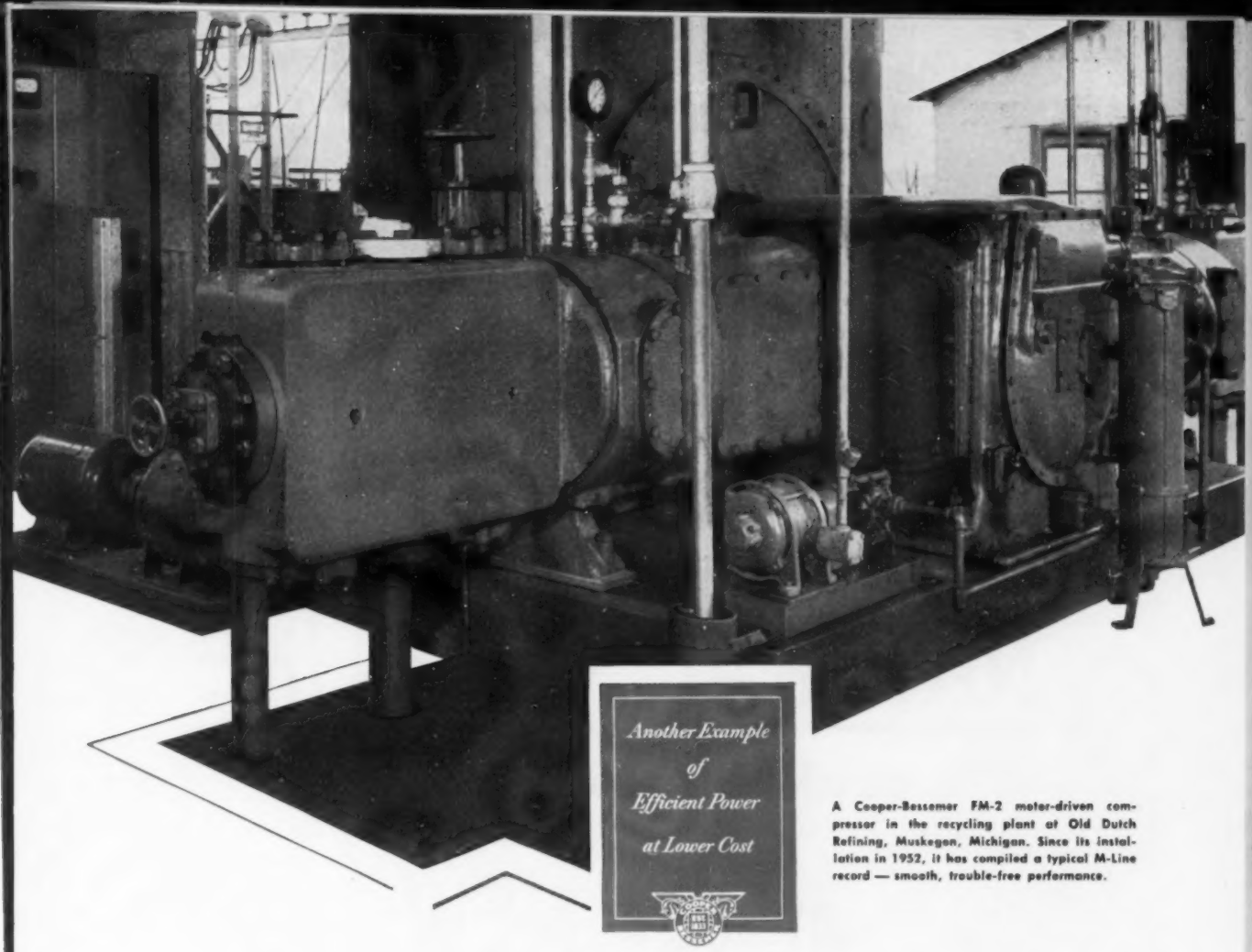
Mr. Plomteaux received a degree in civil engineering from the University of California at Berkeley. He started with Shell at Pittsburg, Calif., in 1940 and has advanced through positions of increasing responsibility while serving also at Cactus and Houston, Texas, and in New York.

F. G. Watson, formerly assistant superintendent, has been appointed superintendent of Shell Chemical Corp.'s Houston plant. His assistant is **D. B. Luckenbill,** who was formerly senior technologist, manufacturing-development department, New York. Replacing Mr. Luckenbill at the head office is **E. S. Martin,** formerly the operations department manager at Houston.

F. A. Horsley has been promoted to superintendent of the works at Shell Point, Pittsburg, Calif., from his post as assistant superintendent of the Shell Chemical plant at Martinez, Calif. Replacing him as assistant superintendent is **A. W. Fairbairn,** who was an assistant department head of the research center at Emeryville, Calif.

T. G. McKenna has been promoted from the assistant superintendent to the superintendent of the Denver, Colo., works, operated by Julius Hyman and Co.

(To obtain more data on advertised products see page 1112)



A Cooper-Bessemer FM-2 motor-driven compressor in the recycling plant at Old Dutch Refining, Muskegon, Michigan. Since its installation in 1952, it has compiled a typical M-Line record — smooth, trouble-free performance.

How UNATTENDED COOPER-BESSEMER RECYCLES HYDROGEN at Old Dutch Refining

RELIABLE, unattended performance has proved to be a top money-saving feature of a Cooper-Bessemer M-Line compressor operating in Old Dutch Refining Company's modern Muskegon, Michigan, plant, leased by Aurora Gasoline Company.

Every day, more than seventeen million cubic feet of hydrogen are recycled by a 2-cylinder single stage Cooper-Bessemer FM-2 used in the UOP Platforming process for upgrading naphthas. Because of automatic controls, this unique compressor runs continuously without the need of operating personnel.

This Cooper-Bessemer unit receives the hydrogen from the reactors and compresses it for recycling to the naphtha heaters.

Continued precision output of the recycling compressor is vital to the successful completion of the entire Platforming process. That is why efficient, compact, Cooper-Bessemer M-Line compressors were chosen for the job.

If your requirements call for either motor or engine driven compressors, get the complete details on Cooper-Bessemers. They are available in sizes from 100 to 5000 horsepower.

MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

AND *Now*

On the West Coast, too . . .

we will have

NATURAL GASOLINE

available in quantity

at our NEW Deepwater Terminal

near

San Pedro, California

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PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

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TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

STEEL VALVES COME OFF THE PRODUCTION LINE in Rockwell Manufacturing Co's new plant at Sulphur Springs, Texas. The location affords easier access to customers in the petroleum and natural gas industries. At present the factory manufactures "Hyperseal" valves in sizes up to four inches and pressure ranges to 10,000 psi., though other Rockwell products eventually will be made there as well. The plant also serves as a distribution center for the organization. The building covers 116,000 sq. ft. and is completely air conditioned.

Houdry Promotes Norris

Eugene Norris has been made a commercial development engineer of the Houdry Process Corp., Philadelphia, Pa. His work in this post is to provide technical assistance to licensees on all Houdry processes, in addition to carrying on sales activities.

A graduate of the University of Pittsburgh with a degree in chemical engineering, Mr. Norris has been associated with the development of moving bed catalytic cracking processes since their inception. He holds several patents in the field of petroleum refining. Since joining the Houdry company, he has served with the technical service division and the process section of the engineering department.

Service Firm Opens Doors

Dwyms Development Co., Inc., has been established as a new technical service firm with offices in Roselle, N. J., and New York City.

The firm is equipped to do analytical work on mineral oil and petrochemical products, test work on rubber and plastic products, market development and sales work on new chemical products, preparation of special organic or scarce chemicals in small quantities and purified to meet highest chemical standards, licensing the manufacture of patented preparations, assisting inventors in the development of products to be patented, and, finally, industrial photography.

The offices in Roselle are at 208 W. Fifth Ave., in New York City at 11 Park Place.

Underwriters' Opens New Lab

Facilities of the Underwriters' Laboratories Inc. were enlarged recently with the opening of the fourth testing station, at Northbrook, Ill. Operating at the new station are the gas and oil department, the burglary protection department, and the extinguisher and sprinkler divisions of the fire protection department.

The new station has been constructed on 153 acres of land northwest of Northbrook and adds approximately 45,000 sq. ft. of floor space to the 120,000 sq. ft. of space at the firm's main office and testing station in Chicago.

Conoflow Opens New Dept.

A new department to handle specialized engineering problems in the sale and application of equipment made by Conoflow Corp. has been set up with E. K. Graham, Jr., formerly chief engineer, as its head. Mr. Graham's title is manager of technical services, and the responsibility of his department is primarily to handle the application of the company's line of "Rotomotors" and "Conomotors," which are used on catalyst valves, large gate valves, variable speed drives, pumps, etc.

Mr. Graham has been with Conoflow for more than 10 years. He is a graduate of the Drexel Institute of Technology and a member of the Instrument Society of America.

INC Promotes Frank LaQue

The International Nickel Co. has promoted Frank L. LaQue from the position of head of the corrosion engineering section of the development and research division to manager of the division and vice-president of the firm. He has replaced Thomas H. Wickenden, who has reached retirement age and who will continue to serve the company as a consultant on special projects.

O. B. J. Fraser and Donald J. Reese will serve as assistant managers of the division.

Mr. LaQue began with the company in 1927, after receiving his B.S. degree from Queen's University, Kingston, Ontario, and started then his activities in the field of corrosion and corrosion-resistant materials. He was assistant director of technical service on mill products from 1937 to 1940. Under his leadership the company's corrosion testing stations at Kure Beach and Harbor Island, North Carolina, were established. He is a member and past president of the National Association of Corrosion Engineers, and holds responsible committee posts in the American Society for Testing Materials and the National Research Council.

Fluor Maintenance Names Winn

John E. Winn has been named to fill the newly created position of president of Fluor Maintenance, Inc., a subsidiary of Fluor Corp., Ltd., Los Angeles engineering and construction company. Previously vice-president in charge of the firm's foreign construction division, Mr. Winn has been with the Fluor for 30 years in positions of increasing importance. He has contributed especially to the building and training of the company's construction force.

Build Home for Enjay Labs

The research and sales development work of Enjay laboratories division, a technical service firm for chemical products sold by the Enjay

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Samples, Specifications and Detailed Information on Request.

TENNESSEE CORPORATION

617-29 Grant Building, Atlanta, Georgia

Co., Inc., will be carried on in quarters now under construction at the Standard Oil Development Co.'s research center at Linden, N. J.

The installation is designed to provide the latest equipment for experimentation on petroleum solvents, additives, chemicals and polymers marketed by the Enjay Co.

The building will contain 11 laboratories and 14 offices and is expected to be in use by November 1, 1954. It is being constructed of brick and cement and will be 54 feet wide and 230 feet long.

Floridin Co. Moves to Florida

The executive and administrative offices of the Floridin Co. have been shifted from Warren, Pa., to Tallahassee, Fla., in a move designed to increase coordination between the branch plants of the company. Floridin manufactures fullers earth, activated bauxite, and commercial adsorbents, and includes branches at Quincy and Jamieson, Fla., Sweet Home, Ark., and Clarendon, Pa. A branch sales office will be maintained at Warren, which was headquarters of the company for 43 years.

In addition to executive and administrative activities the firm will have a research and development laboratory in operation on the site after construction on it is completed in a few weeks.

Personnel Changes

Black, Sivalls & Bryson, Inc.—Ralph W. Nichols to sales manager of the Ft. Worth, Texas, district; Thomas E. Pool to Oklahoma City, Okla., district sales manager.

National Aluminate Corp.—Dr. David G. Braithwaite, production manager of the catalyst division, has been named a vice-president.

Ethyl Corp.—Waldemar J. Distler to assistant manager of sales operations, a new position in the New York office.

Stone & Webster Engineering Corp.—F. W. Argue to engineering manager; W. F. Ryan, vice-president, to senior consulting engineer in charge of report and appraisal activities.

Allis-Chalmers Mfg. Co.—R. C. Allen, from consulting engineer to director of engineering of the general machinery division; L. J. Linde, from assistant general manager and chief engineer of the Boston works to director of electrical engineering, general machinery division.

Koppers Co.—T. C. Keeling, Jr., to assistant vice-president of the chemical division, from Mathieson Chemical Corp.; C. W. Fisher to assistant manager of the chemical and gas department, from chief of the project and technical section; J. S. Joseph to chief of the section, replacing Mr. Fisher, from assistant chief; G. A. Omohundro to assistant chief, from process engineering supervisor; and J. M. Airgood, process engineer, to process engineering supervisor. With the exception of Mr. Keeling, the men are part of the company's engineering and construction division.

Robertshaw-Fulton Controls Co.—Lawrence C. Connolly to manager of the Fielden instrument division's Boston sales office; Donald Daily and William H. Johnson to the Fielden division sales staff.

Rockwell Mfg. Co.—Thomas C. Again to chief engineer of the company's new valve plant at Sulphur Springs, Texas, from assistant chief engineer of the Nordstrom valve plant in Oakland, Calif.; William H. Shenkle to chief engineer of the instrument division at Tulsa, Okla.

Lamson Corp.—William H. Roth to handle conveyor and pallet loader sales in the Philadelphia and Delaware areas; W. Howell Finn to be responsible for sales of "Airtubes" in the same area, plus conveyor and pallet loader sales in southeastern Pennsylvania and the Eastern Shore of Maryland.

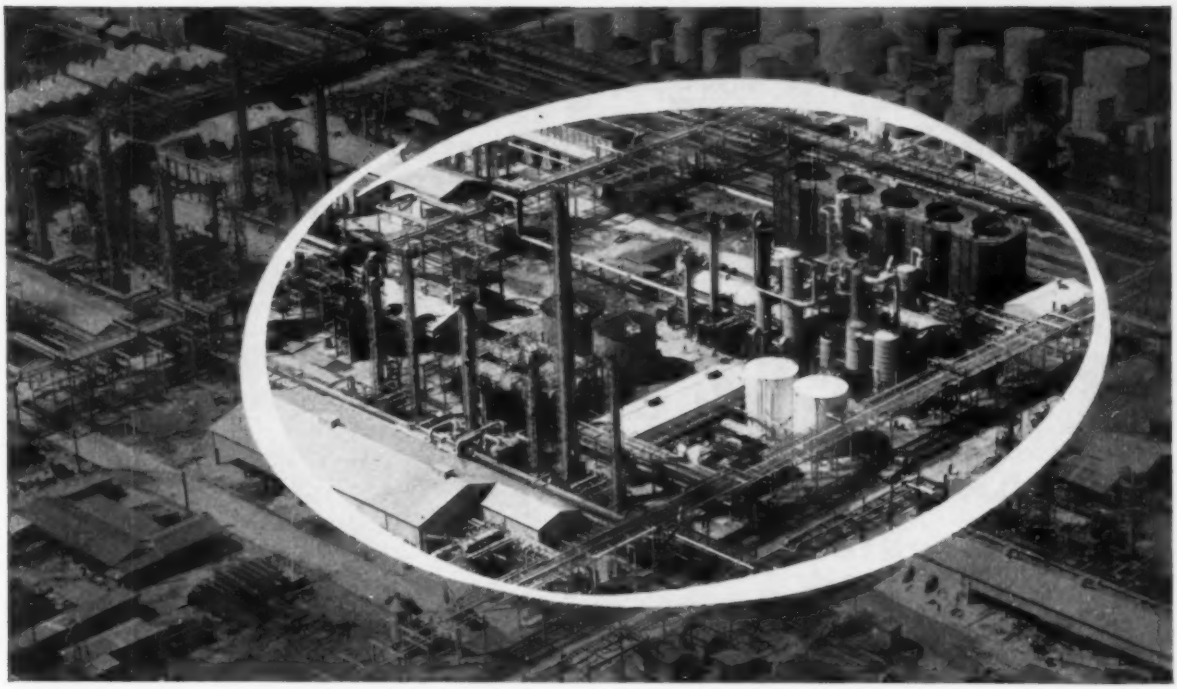
Worthington Corp.—E. W. Theilig to chief engineer of the power pump engineering department, with headquarters at the Oil City, Pa., works; R. K. Grobholz to manager of the reciprocating pump sales section at Oil City.

Neptune Meter Co.—Walter G. Sieger to sales manager of petroleum and industrial meters.

De Laval Steam Turbine Co.—H. G. Bauer to the new post of vice-president and general sales manager, from vice-president of engineering and manager of the marine division; W. A. Neumann to executive vice-president and treasurer of the De Laval Separator Co.

Pacific Coast Engineering Co.—C. H. Ramsden, formerly president of the firm, to chairman of the board; Will C. Hall, general manager and formerly vice-president, to the post of president; C. D. Ramsden to vice-president and chief engineer.

(To obtain more data on advertised products see page 1112)



In this circle purity is an absolute must

...so is Nickel— and here's why

You are looking at a section of Shell Chemical Corporation's Deer Park, Texas, plant.

There, Shell synthesizes glycerine from propylene, with allyl chloride as an intermediate. There, too, the glycerine is evaporated, purified of salt, steam-stripped, distilled and stored.

All this means corrosion and purity problems. Chlorine and propylene are reacted at a temperature which greatly accelerates corrosive attack . . . salt is present in the crude product . . . and there are strict limits on the heavy metals content of glycerine.

Yet Shell successfully combats corrosion to turn out a colorless, odorless product that assays better than 99% glycerol and meets all the usual specification requirements.

How does Shell do it?

With Inconel; in mixing jets for reacting propylene and chlorine at about 950°F. Inconel combines resistance to both heat and corrosion.

With Nickel-Clad Steel; in evaporators, distillation columns, storage tanks . . . wherever glycerine is concentrated. Nickel-Clad Steel combines the protection of Nickel with the economy of steel.

With Monel; in continuous centrifugal filter equipment used to remove sodium chloride by-product. Monel gives high corrosion-resistance and high strength in a single metal.

With pure Nickel; in bubble caps and trays; reboiler and condenser tubes, pumps, and piping. Nickel keeps metal pick-up at a minimum in hard-to-maintain areas.

The correct application of Nickel and Nickel alloys in the production or handling of glycerine can do much to lower costs and improve the quality of the product. Inco's Corrosion Engineering Section will be glad to work with you in solving specific problems connected with purity or corrosion in your own plant. Just write:

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"S"® Monel • Inconel® • Inconel "X"®
Inconel "W"® • Incoloy® • Nimonic® Alloys
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NEW speed...accuracy...dependability...

in the measurement of percentage hydrogen

in liquid hydrocarbons

THE NEW cenco® BETA RAY $^{H}/_{C}$ METER

utilizes radioisotopes

Here is a practical, efficient precision instrument designed for use in research as well as in product control and routine analysis. It provides a fast, accurate means of measuring the percentage of hydrogen, or the hydrogen-carbon ratio, in liquid hydrocarbons.

- ★ Makes complete determination in 5 minutes
- ★ Accurate to within 0.02 weight percent hydrogen
- ★ Handles hydrocarbons ranging from normal pentane to 1.6-dimethylnaphthalene with no change in precision over the full range
- ★ Calibration is independent of pressure changes in ionization chambers since they share a common supply of gas
- ★ Temperature changes do not affect measurement since both specific gravity and beta absorption measurements are made automatically at same temperature
- ★ Twin beam instrument using single beta ray source is independent of source variations
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- ★ Null-point balance is independent of electrometer variations

The New Cenco Beta Ray H/C Meter fills a long felt need in numerous petroleum processing operations . . . where the hydrogen-carbon ratio is altered . . . where the percentage of hydrogen is an index to the performance of end products such as jet fuels, fuel oils, gasolines, etc. Our Bulletin No. 115 contains full details about this precision instrument. Write for your copy today.

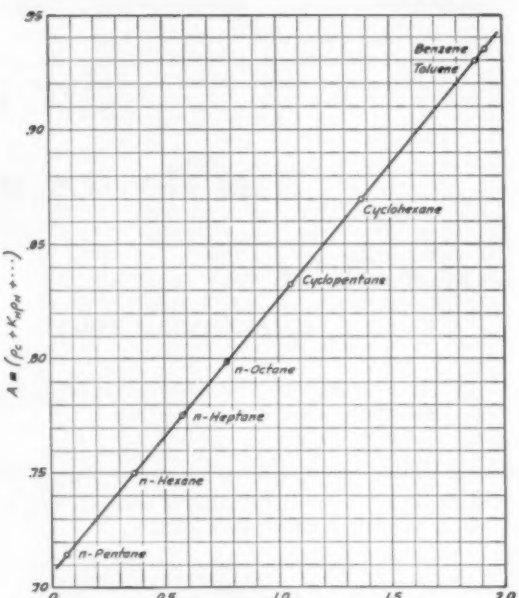

Fig 8. Typical Calibration Curve

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Data on Sulfur Compiled in New Book

The Sulphur Data Book, William N. Tuller, editor, compiled by the technical staff of the Freeport Sulphur Co.; 6x9 in., stiff cloth cover, 143 pp., $5. McGraw-Hill Book Co., 330 W. 42nd St., New York City.

THE authors of this book have brought together information hitherto widely scattered throughout the technical literature. They have also tried to make the book as useful as it is simply informative, though to do so made it necessary to balance this aim against the demands of completeness and to make certain compromises. As the preface states, it was decided to exclude apparently contradictory data, wherever this situation came up, and to choose what the authors felt was the soundest evidence and conclusion. In line with this same object it was found desirable in several places to include data which were completely unsubstantiated or only partly so. With these reservations noted the authors have organized a comprehensive and attractive work, in two colors and provided with a wealth of illustrative material.

The information is arranged in five sections: the nature of sulfur, physical and chemical properties, reaction thermodynamics, solubility, and analysis of sulfur. In addition to a description of the element as a solid, liquid and vapor, the first section contains a phase diagram illustrating the relationships among these forms of sulfur as a function of pressure and of temperature. The section concludes with a discussion of common impurities and the preparation of pure sulfur.

Among the physical and chemical properties discussed in section two are density of the solid and liquid, viscosity of the liquid and the vapor, thermal expansion of the liquid, vapor pressure of rhombic and monoclinic sulfur, melting points, temperatures of crystalline transition, specific-heat equations, heat capacity, enthalpy and entropy, and the thermodynamic properties of superheated sulfur vapor, which are given in tabular form.

Under reaction thermodynamics the book gives the formulae for the specific-heat increase, the enthalpy increase and the free-energy increase. Tables with the equation constants round out the section. Section four, solubility, is divided into three parts: solubility of sulfur in pure solvents, in mixed solvents, and of hydrogen sulfide in sulfur.

Section five, on the analysis of sulfur, describes the procedures used in testing for chloride, acidity, moisture, ash, carbon (three methods), elemental sulfur, combined sulfur (the Parr-bomb method), arsenic, and selenium. The first part of the appendix contains 12 pages of conversion tables for sulfuric acid and fuming sulfuric acid. The appendix concludes with a bibliography of sources cited in the text.

Comprehensive Study on Welding Released

Metals and How to Weld Them, by T. B. Jefferson and Gorham Woods; 6x9 in., 322 pp., stiff cloth cover, $2. The James Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

A TEXTBOOK on welding techniques and fundamentals, this volume is intended to be useful to a wide assortment of people—the high-school student, the graduate engineer, or the craftsman—practically anyone who needs to use or know about welding. The authors assume no prior knowledge of the subject on the part of the reader, and for that reason have devoted nine out of 20 chapters to the fundamentals — the mechanical and physical properties of metals, the basis of metallurgy, heat treating and welding, and a brief historical account of metal working.

The welding of specific metals is the topic of chapters 10 through 18. In these sections the reader will find a thorough discussion of the best techniques and the problems which pertain to working with the principal welding metals. Chapter 10 is about low carbon steel, its properties or limitations and the best way to handle it.

The same procedure is followed in the succeeding chapters: high carbon steel, welding alloy steels, cast iron properties and welding, stainless steels and high chromium alloys, austenitic manganese steel, and, finally, nonferrous metals and alloys. A section on hard-facing in metals follows.

The appendices contain much additional information, including a glossary of welding terms, tables providing equivalents for different standards of hardness, another for equivalents in weights and measures, and a graph showing the cost of deposited weld metal on surfaces varying in area.

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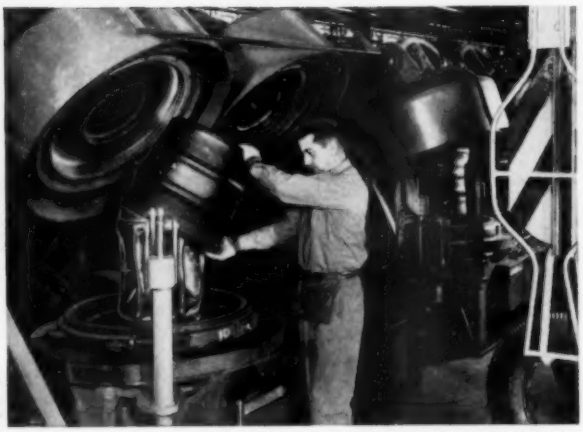

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PARAPOID	JAYSOL	JAYSOL
PARADYNE	Secondary Butyl Alcohol	Iso-Octyl Alcohol
PARATAC	Secondary Butyl Acetate	Decyl Alcohol
PETROHOL	Isopropyl Acetate	Denatured Ethyl Alcohol
Methyl Ethyl Ketone	Acetone	Tridecyl Alcohol
Dewaxing Aid	Methyl Ethyl Ketone	Dicyclopentadiene
Ethyl Ether	Ethyl Ether	Isoprene
Isopropyl Ether	Isopropyl Ether	Butadiene
Reference Fuels	Dicyclopentadiene	Ethyl Ether
	Naphthenic Acids	Isopropyl Ether
	Iso-Octyl Alcohol	Tetrapropylene
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1955 API Refining Meeting To Be Held in St. Louis

THE 20th Mid-Year meeting of the API Division of Refining will be held at the Jefferson Hotel, St. Louis, Mo., May 9-12, 1955. The program now under consideration will have 11 sessions, though two of the topics are still considered only as "possibilities."

There will be two sessions on analytical research and one on each of the following: fuels or lubricants, petroleum products (which might become petrochemicals), training, increased design stresses for steels in pressure vessels, corrosion, processes, and refinery maintenance. The two sessions that have not been definitely scheduled are on product quality control and smoke and fumes.

AIEE Organizes New Petroleum Committee

IN recognition of the growing importance of electrical engineering in the petroleum industry, a petroleum committee has been created in the industrial division of the American Institute of Electrical Engineers. The new committee supplants the organization's subcommittee of the committee on chemical, electrochemical, and electrothermal applications.

John Z. Linsenmeyer, manager, Mining Petroleum and Chemical Engineering, East Pittsburgh, Pa., who was chairman of the subcommittee, has been named chairman of the new committee. E. R. Hoyle, Sinclair Refining Co., East Chicago, Ind., is vice-chairman, and C. R. Olsen, Westinghouse, East Pittsburgh, is secretary.

As one of its first activities the committee is sponsoring the Institute's first electrical conference for the petroleum industry, in conjunction with the Tulsa and Oklahoma City Section of the Institute, at Tulsa on September 27-29.

The conference will explore the possibilities of extending the application of electrical engineering in varied phases of the petroleum industry and will consider some specific instances of new uses for electrical power.

ASME Petroleum Group To Hold Conference

THE petroleum division of the American Society of Mechanical Engineers will hold its annual conference September 27-30 at the Statler Hotel, Los Angeles, Calif.

The conference's 18 technical sessions will cover four main topics: production, transportation, materials, and refining. Among the subjects to be discussed in the refining category are mechanical design requirements of new processes, fire protection and safety, utilities in the refinery, and field and shop work in refinery maintenance. The refining section will be rounded out by a forum on the pressure-piping code and a panel discussion on the unfired pressure vessel code.

Oil Man's Calendar

JULY

University of Michigan, Course on Design of Distillation and Absorption Equipment," Ann Arbor, Mich., July 12-23.

1st Western Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif., July 13-14.

AUGUST

Oil-Shale Conference, U.S. Bureau of Mines, University of Wyoming Science Summer Camp, near Laramie, Wyo., August 10-13.

West Virginia University, 14th annual Appalachian gas measurement short course, Morgantown, W. Va., August 23-25.

SEPTEMBER

1st International Instrument Congress and Exposition, Commercial Museum and Auditorium, Philadelphia, Pa., Sept. 13-24.

National Petroleum Ass'n, 52nd annual meeting, Hotel Traymore, Atlantic City, N. J. Sept. 15-17.

American Institute of Electrical Engineers, first conference on the petroleum industry, Tulsa, Okla., September 27-29.

American Society of Mechanical Engineers, ninth annual petroleum mechanical engineering conference, Statler Hotel, Los Angeles, Calif., September 27-30.

CLASSIFIED

CONSTITUTION OF MINERAL OILS
By Van Nes and Van Westen
Resulting from many years of research at the Royal Dutch Shell Laboratories, this book presents practical information regarding the fractionation of oils, and the analysis of oil fractions. A most useful volume for all petroleum chemists, it applies structural group analysis to practical problems of refining. 508 pp., 108 illus., $9.00.
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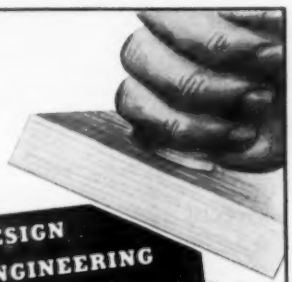
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Information Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ADDITIVE, fuel oil, booklet and samples on request; DuPont de Nemours & Co. See adv't. p. 1090.

ALUMINUM CHLORIDE, anhydrous, sublimed, two grades, technical catalog available; Ohio-Apex Div. See adv't. p. 1133.

ALUMINUM CHLORIDE, anhydrous, in four sizes, data sheet and Bulletin 100 describe this and other company services; Hooker Electrochemical Co. See adv't. p. 1019.

AMMONIA SYNTHESIS, description of recent plant installation in Bulletin HE-4-54; Foster Wheeler Corp. See adv't. p. 1111.

BUBBLE CAPS and other steel processing equipment described in Catalog 52; The Pressed Steel Co. See adv't. p. 996.

CATALYST CARRIERS made of "Alundum," Bulletins 7, 140 and 793; The Norton Co. See adv't. p. 1008-1009.

CATALYST, synthetic fluid cracking, "Aerocat" in three new grades, data sheet available; American Cyanamid Co. See adv't. p. 1007.

CONDUIT, electrical, rigid, aluminum, new booklet; Aluminum Co. of America. See adv't. p. 1020.

CORROSION CONTROL with glassed steel and alloy equipment, information available; The Pfaudler Co. See adv't. p. 1066.

CORROSION INHIBITOR, "Polyrad," a filming amine inhibitor, descriptive brochure; Hercules Powder Co. See adv't. p. 1001.

DETERGENT for tower cleaning, Booklet F 7629 gives details; Oakite Products, Inc. See adv't. p. 1093.

EXPANSION JOINTS, equalizing, hinged, universal, Bulletin 351; Zallea Brothers. See adv't. p. 1011.

FANS for cooling towers and heat exchangers, Bulletin A-111; Hartzell Propeller Fan Co. See adv't. p. 982.

FASTENERS, all types, movie "Holding Power" tells the complete story; Bethlehem Steel Co. See adv't. p. 1117.

FILTERS, for catalyst, to replace cyclones and electrostatic precipitators, literature available; Micro Metallic Corp. See adv't. p. 1127.

FLOW METERS, "Transometer" for measurement and control of viscous fluid, Bulletin 125; Askania Regulator Co. See adv't. p. 1127.

FLUORINE COMPOUNDS for process and research use, information available on many types; General Chemical Div. See adv't. 3rd Cover.

GASKETS, chemical resistant, "Teflon," Bulletin TG-953; U. S. Gasket Co. See adv't. p. 1121.

GENERATOR, oxygen-nitrogen, for low temperature processing, brochure available; Air Products, Inc. See adv't. p. 1012.

HYDROGEN measurement in liquid hydrocarbons with radioisotopes, Bulletin 115; Central Scientific Co. See adv't. p. 1106.

INDICATORS, recorders and controls, electronic data books available; Fielden Instrument Div. See adv't. p. 1122.

INHIBITOR for hydrocarbon oils, gasoline and other distillates, samples and literature on request; Universal Oil Products Co. See adv't. p. 1128.

INSULATION, industrial, technical bulletins available; The Philip Carey Mfg. Co. See adv't. p. 1119.

INSULATION for tanks, pipes and towers, literature and samples on request; Gustin-Bacon Mfg. Co. See adv't. p. 1098, 1130.

LEAD for control of sulfuric acid corrosion, new booklet "Chemical Lead Products"; National Lead Co. See adv't. p. 1021.

MASTICS, insulating and corrosion resisting, catalog on request; Earl Paint Corp. See adv't. p. 1030.

MATERIAL HANDLING, "Truckster" for inner plant handling and delivery, illustrated booklet; Cushman Motor Works. See adv't. p. 1107.

MIXERS, side and top entering, nine catalogs available; Mixing Equipment Co. See adv't. p. 1036.

MOTOR STARTERS for hazardous locations, Booklet 1062; The Electric Controller and Mfg. Co. See adv't. p. 1085.

PACKINGS for shafts and rotating equipment, File DMPP; Durametallic Corp. See adv't. p. 1133.

PAINT, corrosion resisting, "Tygon," Bulletin 750; U. S. Stoneware Co. See adv't. p. 1015.

PIPE CUTTERS, hinged, for pipe 2½" to 12" in diameter, descriptive literature available; Reed Mfg. Co. See adv't. p. 1095.

PIPE, fittings and valves, "Saran Lined," catalog available; Dow Chemical Co. See adv't. p. 1132.

PUMPS, proportioning, for small volume flows, Catalog UP-54; Hills-McCanna Co. See adv't. p. 995.

REFRACTORY LINING, hydraulic setting, castable, Brochure RC-28A on "Blazecrete" and "Firecrete"; Johns-Manville. See adv't. p. 1129.

SPECTROPHOTOMETER, for near-infrared region, data file 98-25; Beckman Instruments, Inc. See adv't. p. 1002.

STEAM TRAPS, impulse type, Steam Trap Selector available; Yarnall-Waring Co. See adv't. p. 1018.

STEAM GENERATOR, bent tube, burns various fuels, bulletin available; Henry Vogt Machine Co. See adv't. p. 1000.

STEEL, stainless, for refinery service, booklet gives extensive data on performance; U. S. Steel Corp. See adv't. p. 1096.

SULFUR DIOXIDE for processing, samples, specifications and detailed information on request; Tennessee Corp. See adv't. p. 1104.

SWIVEL JOINT, ball bearings, many styles and sizes, catalog information available; Chiksan Co. See adv't. p. 1089.

THERMOMETERS, dial, various mountings, catalog information on request; Palmer Thermometers, Inc. See adv't. p. 1092.

TUBES AND PLATES, condenser and heat exchanger, Publication B-2; The American Brass Co. See adv't. p. 1033.

TUBES, condenser, of many metals, "Condenser Tube Book" available; Wolverine Tube Div. See adv't. p. 1023.

VALVES, lubricated plug, Reference Book 39; Homestead Valve Mfg. Co. See adv't. p. 1013.

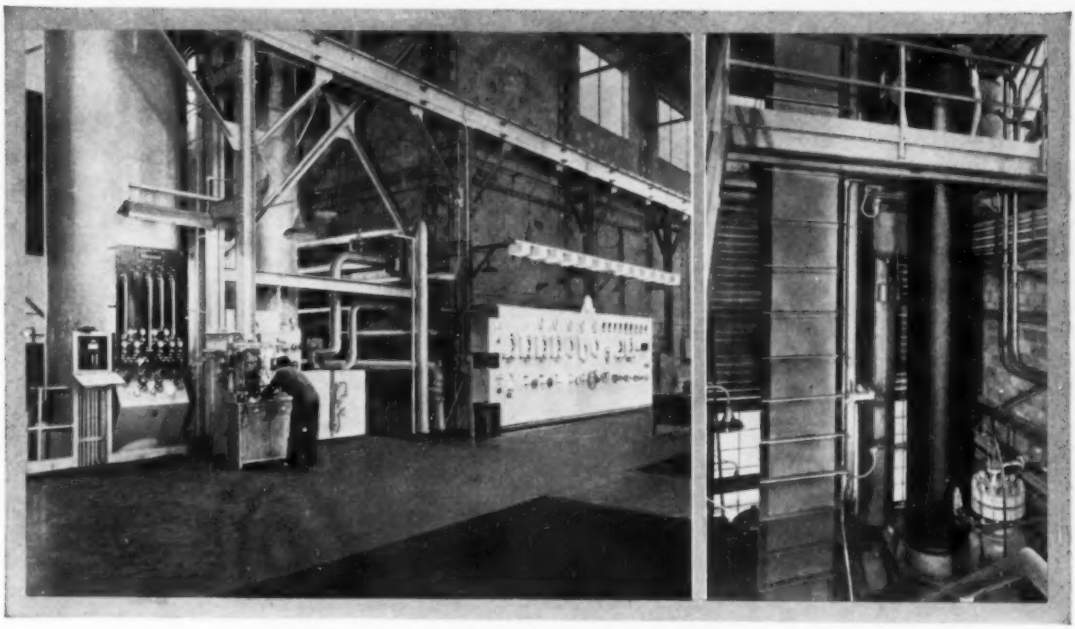
VALVES, coated steel plug, three types, catalog available; Wedgeplug Valve Co., Inc. See adv't. p. 1031.

VALVES, globe, gate, check, "Koncentrik-Fitted," illustrated descriptive circular; The Wm. Powell Co. See adv't. p. 1006.

VENTING EQUIPMENT for volatile and inflammable liquids, Bulletin CP-2001; Vapor Recovery Systems. See adv't. p. 1125.

WATER SEPARATORS for refinery service, Process Manual R-101-53; Warner Lewis Co. See adv't. p. 1100.

excess H_2 to NH_3 by Casale ammonia synthesis



55 Tons per day of liquid anhydrous Ammonia is being produced at this new plant of the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan. The Hydrogen is a by-product from Pennsalt's adjacent chlorine plant.

The photographs show the Liquid Air Plant and the control board in the compressor building; also, the Casale ammonia condenser, deoxidation reactor and convertor.

For a general description of this installation, designed, constructed and licensed by Foster Wheeler:

write for HE—4-54

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK

 (To obtain more data on advertised products see page 1112)

ADVERTISERS' INDEX

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FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

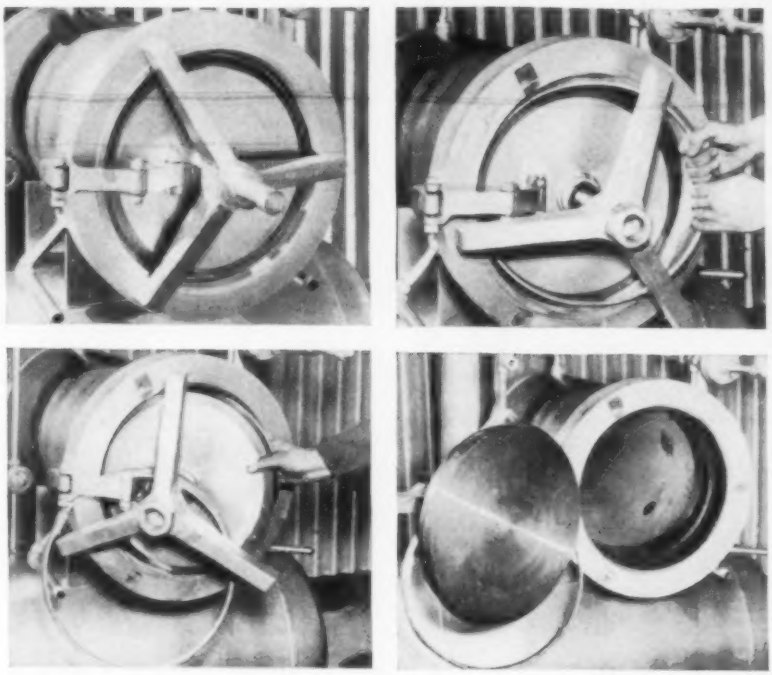
Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

WHAT'S NEW . . .



More Pressure Makes Tighter Seal

Because the new "Flex Ring Closure"—for all types of pressure vessels and piping systems—incorporates an internal pressure closing, metal-to-metal seal principle, it seals tighter as the pressure on it increases. Advantages claimed for it include: less time in opening and closing (only one bolt to operate); less weight; fewer parts; better seal, more safety, space savings, and lower initial cost.

The closure consists of four main parts—weld neck, plug, gasket, and spider. A patented flexible metal gasket is held in compression between the plug and weld neck. This gasket is flexed to an elliptical shape to allow it to pass through the plug opening. Once in place, tightening of the spider nut returns the gasket to its round shape for proper seating.

The closures are available in the same pressure ratings as ASA flanges and have the same pressure and temperature rating as corresponding ASA raised face flanges. In the illustration above: top left picture shows unit assembled as in service; top right shows spider released, gasket being removed; bottom left shows after gasket removal, plug is rotated to open; bottom right shows unit completely opened.

Sillers Engrg. Co., Box 7193, Dallas, Texas.

Circle No. **1** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.

New Vapor Equivalent Device Useful for Natural Gas Residues

. . . in determination of vapor equivalent and molecular weight. That is, it is an apparatus designed to measure the volume of vapor which is equivalent to a unit volume of liquid after it has been vaporized. However, it can be applied to any liquid which has a vapor pressure of more than 4 mm. of Hg at the temperature of the vaporization bulb. It provides, in one compact unit, a vaporization bulb with an integral multiplying manometer and a removable sample entry system consisting of an orifice and matching pycnometer. The unit is mounted in an all-glass, constant-temperature bath with stainless steel snap-in clamps, and is supplied with a pre-formed immersion heater. The procedure for use consists of filling the pycnometer with sample, admitting the sample to the previously evacuated vaporization bulb, and reading the pressure on the multiplying manometer. The molecular weight is then calculated from the previously determined specific gravity. The apparatus measures vapor equivalent as gaseous milliliters per liquid milliliter, and has a sensitivity of 1.5 ml. for each millimeter on the manometer scale. Phillips Petroleum Co., Instrument Sales Div., Bartlesville, Okla.

Circle No. **2** *on Reply Card*

New Line of Globe-type Valves Is Made of Polyvinyl Chloride

. . . plastic material. The stem can be repacked with Teflon packing even under full line pressure. No packing of any type is needed at the valve seat, and the disc is easily replaceable. A one-inch valve has been repeatedly tested at 1500 psi. and will operate at a working pressure of 150 psi. at room temperature. Corrosion-resistant, the valve is said to be applicable in petroleum and chemical processing where medium pressures and temperatures not exceeding 160° F. are required. Valves are made to fit pipe sizes of ½, 1, and 1½ in. Stokes Molded Products, Taylor & Webster Sts., Trenton 4, N. J.

Circle No. **3** *on Reply Card*

Foam Blanket Keeps Tanks Cool

Designed as a protective technique for large tanks and manufacturing areas that have been left unprotected because of the possible high cost of installing permanent water spray systems, a new foam material, "Unox," has been developed by Carbide and Carbon Chemicals Co.

The picture above illustrates a test conducted by the manufacturer at Insitute, W. Va., in which the Unox foam blanket was cascaded over the outside surface of a 55,000-gal, storage tank while it was surrounded by a raging kerosene fire in the dyke area for 51 minutes. Because of the insulating property of the Unox, the temperature of the tank's contents (water in this case for test purposes) increased a total of only 7.9° C.

The technique of using the new foam material involves aeration of a solution of 1% Unox. Presently available foam-type application equipment can be used. In the case of the storage tank, the foam stream is carried to the top of the tank in an applicator pipe and allowed to flow over the roof and thence down the sides of the tank.

Though not discussed by the maker in detail, the heat insulating property of the material seems primarily due to the water it contains which can absorb most of the heat generated during a fire.

Extinguishment tests, also conducted at Institute, proved out the Unox for that purpose as well as for insulation. The material is a so-called penetrant and thereby increases the efficiency of the water portion of the foam, permitting it to reach burning surfaces that are normally water-repellent.

The manufacturer states the Unox foam system can reduce the amount of water needed—either for protection of tanks and structures or for fire extinguishment—by about 60%, thereby reducing the cost of a protection system very appreciably.

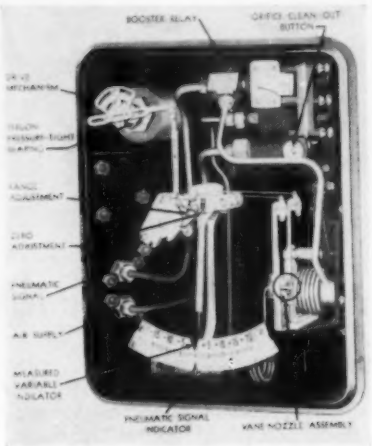
Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

Circle No. **4** *on Reply Card*

Vent Pipes, Ducts, Fittings Are Made of Glass Fiber-Plastic

. . . combination, described as a polyester bonded fiber glass. Named "Du Verre No. 11," this line of equipment has a fiber glass mat impregnated and bonded under pressure with the resin to form a dense, homogeneous product, in which delamination is said to be almost impossible. The prefabricated sections, elbows, tees, and fittings can be installed rapidly in the field with inexperienced labor and simple tools, according to the manufacturer. Lightness and strength of the material reduces the number of hangers that might be required. Du Verre, Inc., P. O. Box 97, Hamburg, N. Y.

Circle No. **5** *on Reply Card*

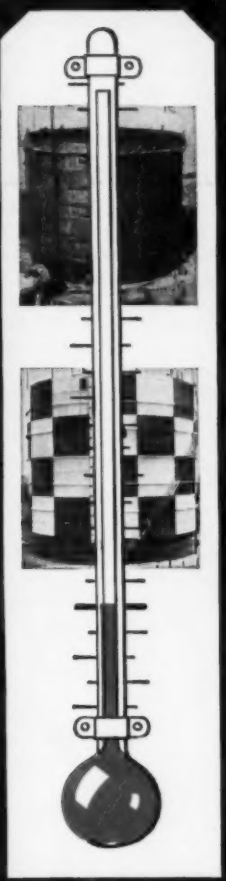


New Pneumatic Transmitter Is Available in Universal Design

. . . permitting simplified telemetering and control systems. The new instrument will transmit measurements of flow, level, pressure, temperature, draft, differential, and vacuum. The measuring element actuates the transmitter's micro-sensitive vane, nozzle, and booster assembly. Transmitted signals of 3-15 and 3-27 psi. may actuate pneumatic receivers and/or controllers. Both the measured variable and the pneumatic signal are indicated on a common scale for easy checking and comparison. The unit is approximately 8 x 10 x 3½ in. in size. The casing is weather-, vibration-, and corrosion-resistant. Accuracy is within ± 0.5% of measured range span, and air consumption is less than 0.15 CFM. Capacity is approximately 3 CFM with a drop of 1 psig. from a signal of 15 psig. Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Circle No. **6** *on Reply Card*

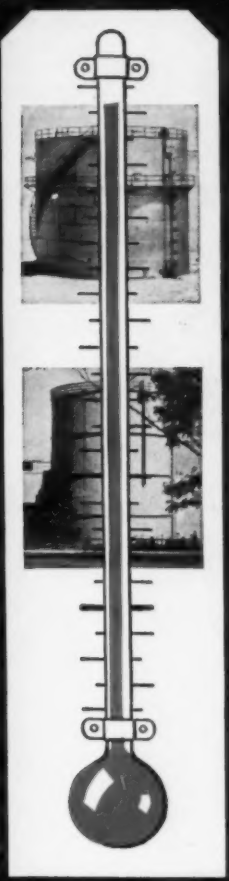
from the **ARCTIC** to the **TROPICS**



more than

130

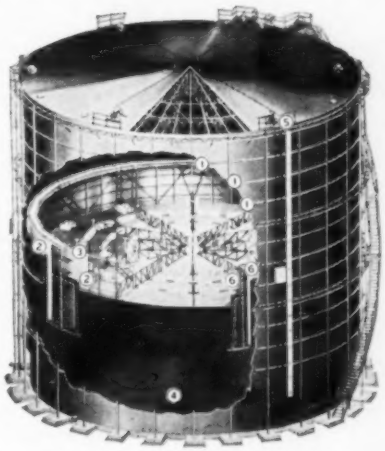
WIGGINS GASHOLDERS have eliminated operating costs for users of chemical process and industrial gases



This 100% dry seal gasholder (no water, no tar, no grease) has proved itself under every condition of climate and temperature. Because of the seal and the simple operating mechanism, operating costs have been entirely eliminated. Comparison of maintenance expense by owners of Wiggins gasholders also shows remarkable savings. Companies who have converted old-type gasholders to the Wiggins advantages have been able to enjoy similar savings. Write for information.

PISTON RISES NEARLY TO TOP—MINIMUM OF WASTE SPACE
CAN BE BUILT ANY SIZE • NO CONTAMINATION OF GAS

1. Space above piston completely ventilated
2. Wide clearances simplify operation.
3. Gas-tight frictionless seal not affected by weather.
4. Piston rests on bottom when empty—less than ½ of 1% dead space for purging.
5. Leveling device—independent of side wall—keeps piston level.
6. Fenders prevent all tension in seal.



Wiggins Gasholder

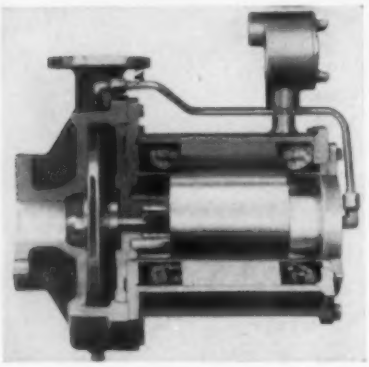
by GENERAL AMERICAN

WIGGINS VAPOR SEALS
GENERAL AMERICAN
TRADE MARK

General American Transportation Corporation
135 SOUTH LA SALLE STREET • CHICAGO 90, ILLINOIS

Offices in Principal Cities

Export Dept.: 380 Madison Avenue, New York 17, N. Y.
Plants: Birmingham Ala. • East Chicago, Ind. • Sharon, Pa.
In Canada: Toronto Iron Works, Ltd., Toronto, Ontario



Seal-less Centrifugal Pump Has Guarantee Against Any Leakage

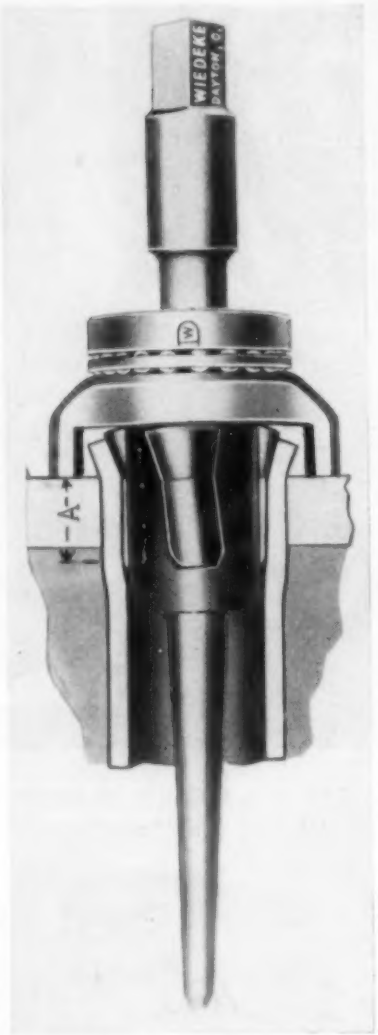
. . . and in addition has a welded construction that allows field dismantling and re-assembly with no loss of the leak-proof qualities. O-rings, used in earlier models, have been completely eliminated. The new pump has already been placed in service on applications ranging from butyl acetate to titanium tetrachloride. It has also been used for hot sulfite liquor, hydrocyanic acid, and molten sulfur. Chempump Corp., Station R, 1300 East Mermaid Lane, Philadelphia 18, Penna.

Circle No. **7** *on Reply Card*

Continuous Oxygen Analyzer Is For Low Range Measurements

. . . in gaseous streams. It is designed for specific determination of oxygen without interference by most other gaseous components, and is claimed to have good reproducibility over extended periods of time. Successful installations have been made, it is said, where a full scale deflection of 50 ppm. of oxygen has been obtained. In operation: the gas sample bubbles into an aqueous solution of cuprous ammonium chloride. The presence of oxygen forms cupric ions, which impart a blue color to the solution. Two photoelectronic type photometers measure the transmitted light. Equipment available with the instrument includes a self-supporting panel, a single point continuous indicator and recorder, circular chart recorder, flow chain cabinet with Plexiglas window, and an explosion-proof circuit breaker and pump. Scrubbers, saturators, and regenerator reservoirs, fabricated from clear plastic, are panel mounted and accessible. All parts of the analyzer which contact the sample are fabricated from stainless steel or plastic. In the standard model, the light source, the power switch and pump motor are explosion-proof, and all other electrical components are air-purged. Davis Instruments Div., Newark, N. J.

Circle No. **8** *on Reply Card*



Package Boiler Tube Expanders Can Roll Closely Spaced Tubes

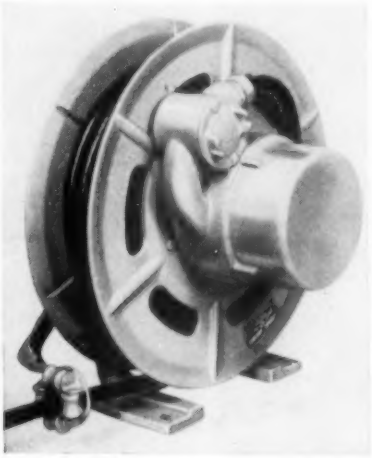
. . . in thin tube sheets. Available in a complete range of sizes, the new, parallel rolling and flaring type "Ideal" Expander has a guard which holds the flare roll back while the tube is being rolled and flared into the tube sheet. A ball thrust bearing, located between the guard and the tube expander frame reduces friction to a minimum to provide long service life. A similar parallel, rolling type (non-flaring) expander is also available for re-rolling tubes after beading for touching up leaky tubes after the unit has been in service. Gustav Wiedeke Co., Dayton, Ohio.

Circle No. **9** *on Reply Card*

New Arc Welding Machine Will Handle Both AC and DC Work

. . . in a single unit, the Model DA-200. A flip of a switch gives the desired current. It is possible to change from one current to the other during a welding job to take advantage of the characteristics best suited for the particular work at hand. The new unit has an AC welding service range of 7 to 275 amps. and a DC service range from 7 to 200 amps. It operates on 220/440 volt, 50/60 cycle current, single phase. It is equipped with the manufacturer's "Dial-lectric" control, which provides instantaneous heat selection. For remote control, the radio-type dial may be taken to the work. Harnischfeger Corp., 4605 West National Ave., Milwaukee, Wis.

Circle No. **10** *on Reply Card*



New Electrical Cable Reel Is Designed for Explosive Areas

. . . such as refineries and the like. The explosion-proof "Spring-O-Matic Powereel" is designed for all cable sizes and is equipped with a ball-bearing spring retractable mechanism that handles most jobs such as on cranes, hoists, conveyors, portable electrical equipment, etc. It also has an adjustable cable guide in standard four-roller or swivel type. The collector ring is designed for heavy duty oscillating operation. The reel is available with or without the cable. Industrial Electrical Works, Box 34, 1509 Chicago St., Omaha 2, Nebr.

Circle No. **11** *on Reply Card*

"Holding Power" is an interesting new industrial film which tells the complete story of fasteners. It describes common, everyday fastener items, such as bolts, nuts, rivets, track bolts and spikes, and shows how important they are to our modern way of life. The film also includes roof bolts, high-strength bolts, oil-well sucker rods, and a wide range of ingeniously designed special bolts.

"Holding Power" is in color, with sound. It is on 16 mm film, and runs about 25 minutes.

The film is intended not only for those closely associated with the fastener field, but also for general-type audiences. There is no charge for this educational picture, except for return postage. If you would like to use a print, write fully to Room 1025, Publications Department, Bethlehem Steel Company, Bethlehem, Pa., preferably well in advance of your showing date.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

(To obtain more data on advertised products see page 1112)

"Tube Troubles?

. . . we licked those long ago . . . with AIRETOOL tube cleaners and tube expanders"

Airetool Series 6000 motors have ball-bearing thrusts front and rear . . . reducing friction to give more power. "Slip-fit" construction . . . no tools needed. Single expansion-type cutter head rapidly and thoroughly cleans coke from straight tubes.

Tube ends in condensers and heat exchangers are automatically rolled to consistently accurate, tight joints with the Airetool Automatic Tube Expansion System. Precise control eliminates over-expanding of tubes and distortion of tube sheets; provides maximum bonding to insure trouble-free tube joints.

When production lags, profits quickly go down! Keep your production at high levels by eliminating expensive shutdowns due to tube failure . . . simply and easily . . . by using Airetool Tube Cleaners and Expanders regularly, to keep your tubular equipment at peak efficiency. Powerful Airetool motors permit the use of any combination of cutter, drill or brush cleaner heads; safely, completely removing all types of scale, coke, or other foreign deposits from straight and curved tubes of any diameter or radius. If your tube problems are causing your production worries, our tube maintenance experts can help you! Write to us today.

There's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

REPRESENTATIVES:
Representatives in principal cities of U.S.A., Canada, Mexico, South America, England.

BRANCH OFFICES:
New York, Philadelphia, Chicago, Tulsa, Houston, Baton Rouge

Three New Grades Developed in Microspheroidal Fluid Catalyst

. . . for cracking operations. The three new grades of the "Aerocat MS" catalyst have been designated as Grade 50/60 (light), Grade 60/70 (intermediate), and Grade 75/85 (narrow). Grade 50/60 has been designed especially for Fluid units which operate at low velocities and are equipped with exceptionally good catalyst recovery facilities. Grade 60/70 is designed for units operating at moderate to low velocities with "average" recovery equipment. Grade 75/85 is for units which operate at the highest velocities and have limited recovery equipment. American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

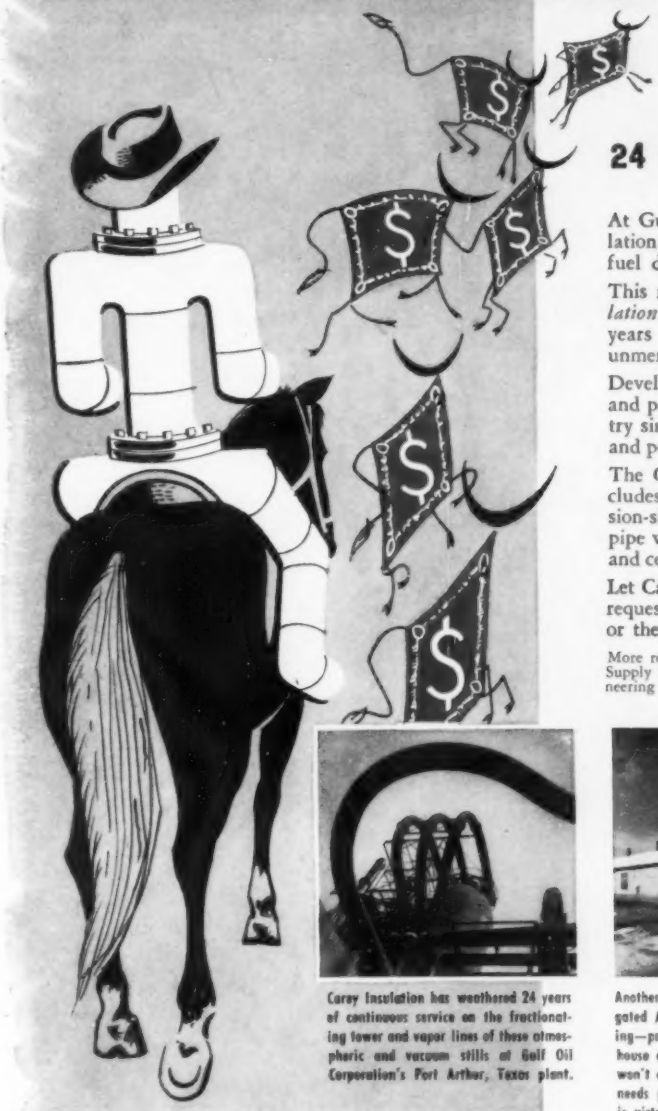
Circle No. **12** *on Reply Card*

New, Multi-speed Laboratory Viscometer Has Wide Versatility

. . . for such determinations as plastic viscosity, yield point, gel strength, and for thixotropic studies. All readings on the "Fann Model 35 V-G Meter" are taken from an engraved dial and are in absolute units. Spindle speeds of 3, 6, 100, 200, 300, and 600 rpm. are obtained through a precision gear train driven by a 115-volt, 60-cycle synchronous motor. Speeds are selected and changed without stopping rotation, a feature of help in working with fluids other than Newtonians. A 500-ml., stainless steel sample cup with scribed line for proper filling is furnished with the instrument. Maximum ranges are: plastic viscosity, 150 centipoises; yield point, 280 lb./100 sq. ft.; gel strength, 300 lb./100 sq. ft. Geophysical Machine Works, 3202 Argonne, Houston, Texas.

Circle No. **13** *on Reply Card*

Carey 85% MAGNESIA INSULATIONS RIDE HERD ON COSTS FOR GULF IN TEXAS



. . . still going strong after 24 years of tough refinery service

At Gulf's Port Arthur, Texas, refinery, miles of Carey insulation keep fluids at constant temperature, save thousands of fuel dollars . . . help Gulf refine better products at less cost!

This record of service dates from 1929, *yet the original insulation is still on the job* . . . still *riding herd* on costs after 24 years of punishment by blistering sun, blustering wind, and unmerciful vibration, expansion and contraction of equipment.

Development and manufacture of products to conserve heat and power has been an important Carey contribution to industry since 1873. That's why we believe we can solve your heat and power conservation problems, unusual though they may be.

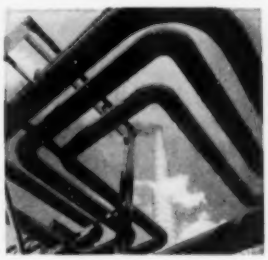
The Carey line of high and low temperature insulations includes new, monolithic Super-Light 85% magnesia in precision-sized blocks and nesting "O.D." pipe coverings, blankets, pipe wrapping and jackets, blocks, loose and granulated wool, and cements.

Let Carey help you plug up those dollar-leaks. Use coupon to request the latest bulletins describing Carey insulating products or the services of a qualified Carey Industrial Sales Engineer.

More recent Gulf Oil installations have been made by: B & B Engineering & Supply Co., Insulation Contractors, Houston, Texas; The Lummus Co., Engineering Contractors, New York City, N. Y.

Carey Insulation has weathered 24 years of continuous service on the fractionating tower and vapor lines of these atmospheric and vacuum stills at Gulf Oil Corporation's Port Arthur, Texas plant.

Another Carey product—Careystone Corrugated Asbestos-Cement Roofing and Siding—protects Gulf Oil Corporation's warehouse at Port Arthur, Texas. Careystone won't corrode, rot, rust or decay; never needs paint or preservative treatments; is virtually maintenance-free!



"Worm's eye" view of live and exhaust steam lines insulated with Carey Insulations. Besides the usual hazards of expansion, contraction and vibration, this Carey installation stands up under the extremely hot, humid weather of the Gulf area.

FROM THE HOUSE OF CAREY

Insulation • Built-up Roofing • Careystone Roofing and Siding • Careyduct • Asphalt Plank • Asphalt Paints and Coatings • Industrial Flooring • Other Famous Products for Industry Since 1873

Carey

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio
In Canada: The Philip Carey Co., Ltd, 277 Duke St., Montreal 3, P. Q.

FILL IN AND MAIL THIS COUPON TODAY

The Philip Carey Mfg. Company
Department PP-7
Lockland, Cincinnati 15, Ohio

☐ *Please send me latest technical bulletins describing Carey industrial insulation products and their uses.*

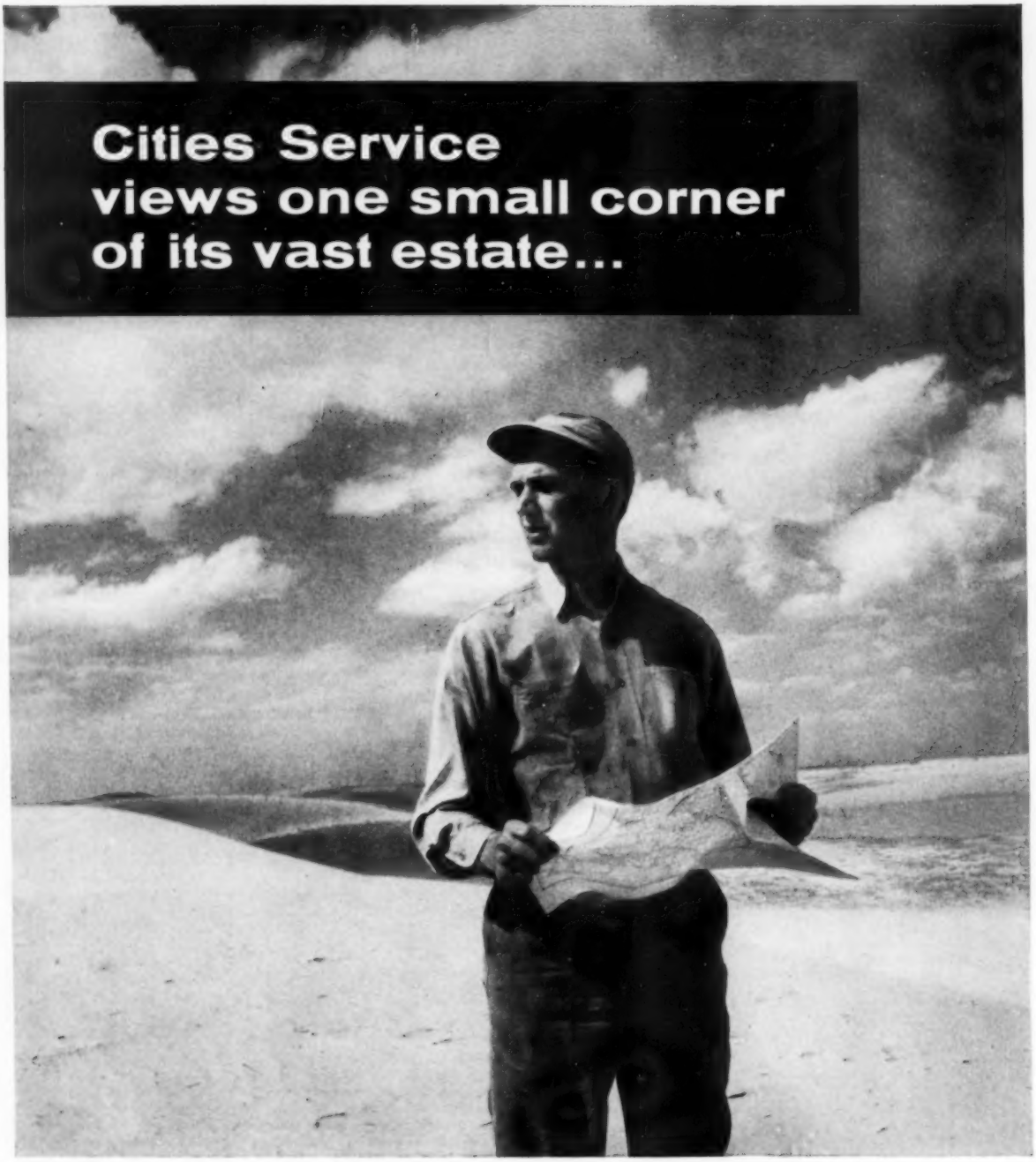
☐ *Please have a Carey Industrial Sales Engineer call on me.*

NAME_____

COMPANY_____

ADDRESS_____

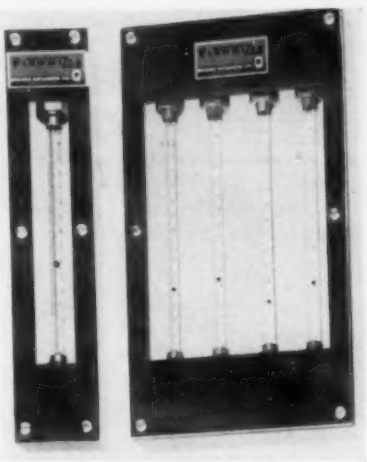
CITY_____ ZONE___ STATE_____



Eleven million acres of prospective oil and gas lands in the United States and Canada—in addition to holdings in South America, Egypt, and the Middle East—are under lease or owned outright by

CITIES SERVICE

A Growth Company



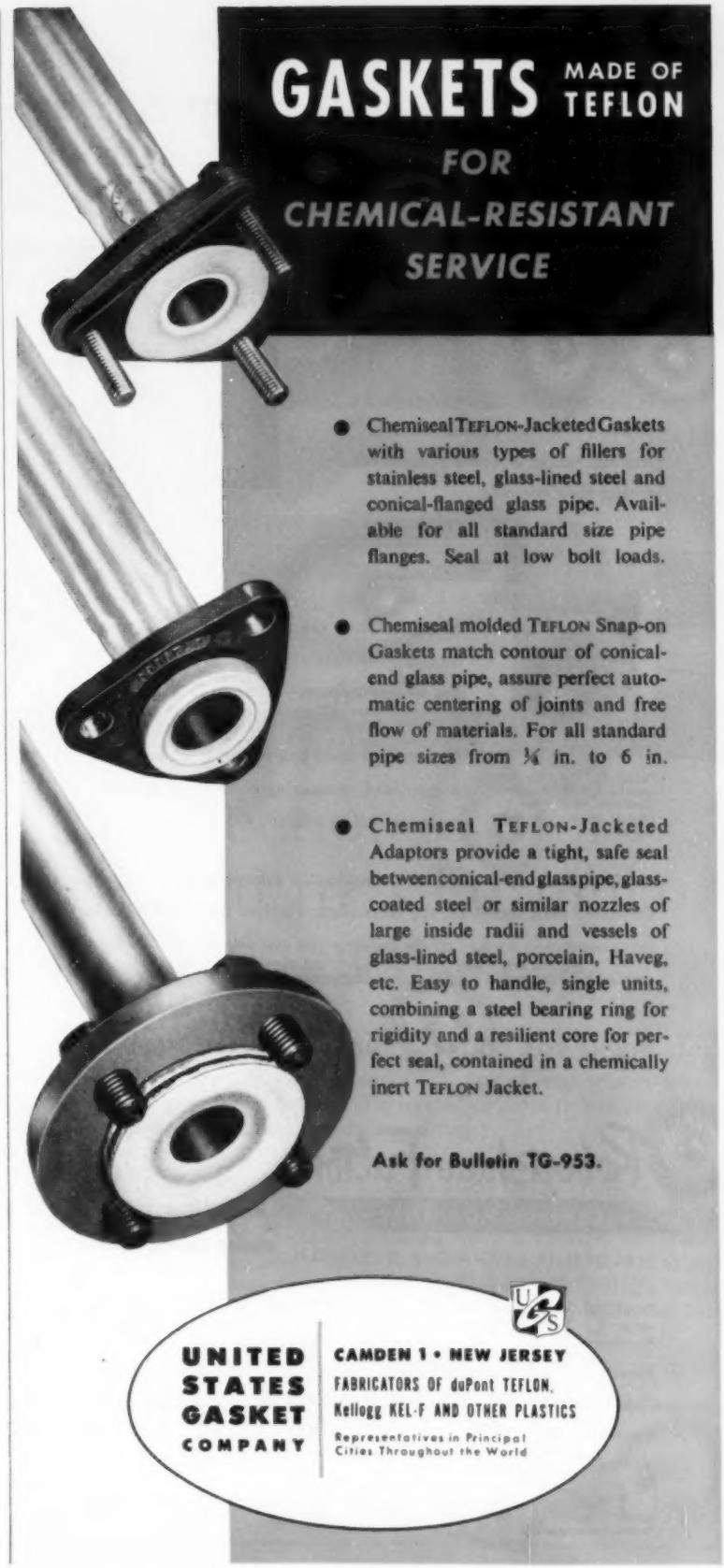
Variable-Area Flowmeters Use Arbitrary Scales to Reduce Cost

. . . and widen applications to marginal fields. Available in two styles, the new "Flow-Mizer" is designed to provide full "Rotameter" accuracy on non-corrosive liquids and gases at moderate pressures. They have a one-piece steel case and may be flush panel-mounted or installed directly in a pipeline. Self-aligning metering tube assembly includes the manufacturer's "Tru-Taper" precision bore Pyrex metering tube. An O-ring seal eliminates leakage. Over-all capacity ranges are from 0.05 cc./min. to 15 gpm. of water, and 5 cc./min. to 25 cfm. of air. Standard accuracies are ±5%, or units may be individually calibrated to provide ±2% accuracy. In addition to the arbitary scales, units may be had with direct-reading, etched metering tubes at slight additional cost. The dual-range model eliminates changing tubes and floats by utilizing two floats in a single tube. The multi-tube model has up to six tubes. Multi-tube units may be all one size or combine various size groups. Brooks Rotameter Co., Lansdale, Penna.

Circle No. **14** *on Reply Card*

Small Bellows Valves Designed For Mass Spectrometer Work

. . . or highly corrosive applications and for high vacuum service. This group of valves, designated the 440 Series, incorporates an inert arc-welded bellows assembly of 18-8 stainless steel. Tests have shown this assembly is capable of withstanding more than 100,000 cycles at low pressure in non-corrosive service. The valve body is of 316 stainless steel, with a Teflon seat and gasket. Both seat and bellows assembly are replaceable. The valves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● Chemiseal TEFLON-Jacketed Gaskets with various types of fillers for stainless steel, glass-lined steel and conical-flanged glass pipe. Available for all standard size pipe flanges. Seal at low bolt loads.
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● Chemiseal TEFLON-Jacketed Adaptors provide a tight, safe seal between conical-end glass pipe, glass-coated steel or similar nozzles of large inside radii and vessels of glass-lined steel, porcelain, Haveg, etc. Easy to handle, single units, combining a steel bearing ring for rigidity and a resilient core for perfect seal, contained in a chemically inert TEFLON Jacket.
Ask for Bulletin TG-953.
UNITED STATES GASKET COMPANY
CAMDEN 1 • NEW JERSEY
FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS
Representatives in Principal Cities Throughout the World

(To obtain more data on advertised products see page 1112)

must you pay a premium price for accurate instrumentation?

fielden says, "no!"—

with precise yet sensibly priced instruments like this TELSTOR Electronic Level Indicator. TELSTOR measures continuously—with accuracies to ±2%—the levels of liquids, viscous fluids, powders or granular solids. Remote readings can be recorded at distances greater than one mile.

Fielden TELSTOR Electronic Level Indicator for Accurate, Continuous Level Measurement of Liquids or Divided Solids.

Simplification is the reason for Fielden's economical instrumentation. TELSTOR, for example, has no moving parts—no floats to stick or leak—no pneumatic or hydraulic piping. Circuitry is simplicity itself and only one vacuum tube is employed. Measuring electrode and instrument are easily installed.

Unless you really *need* instrumentation of *extreme precision* (which inevitably costs more) get the facts about Fielden. *Simplified* Fielden instrumentation assures *all the accuracy you can use*—at an extremely worthwhile saving in initial cost and maintenance.

DOLLAR FOR DOLLAR—YOUR BEST INSTRUMENT VALUE

SEND FOR NEW INSTRUMENT DATA TODAY.

Robertshaw-Fulton CONTROLS COMPANY

FIELDEN INSTRUMENT DIVISION
2920 N. 4th St., Dept. K, Philadelphia 33, Pa.

Send full details of Fielden simplified ☐ TELSTOR Electronic Level Indicator ☐ TEKTOR Electronic Level Control ☐ TEKTOLOG Electronic Recorder.

*Name*_____

*Title*_____

*Company*_____

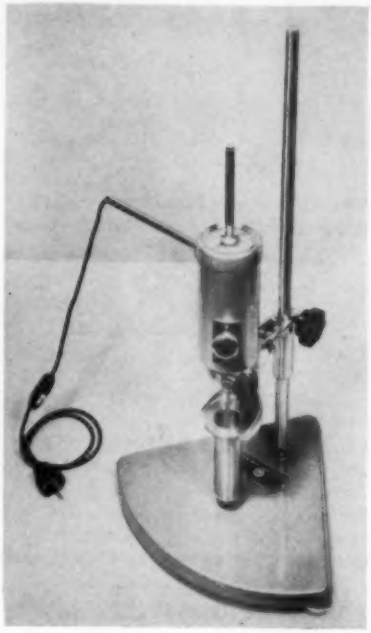
*Address*_____ *City*_____ *State*_____

Fielden TEKTOR Electronic Level Control

Fielden TEKTOLOG Electronic Recorder

provide a low leakage rate across the seat and into the valve (less than 0.001 micron CFH). Pipe sizes available are ⅛ to ½ in., with ¼ and ½ in. Swagelok tube ends. On special order, the ⅛ and ¼ in. valves are available with air-operated motor for remote operation. Hoke, Inc., 159 So. Dean St., Englewood, N. J.

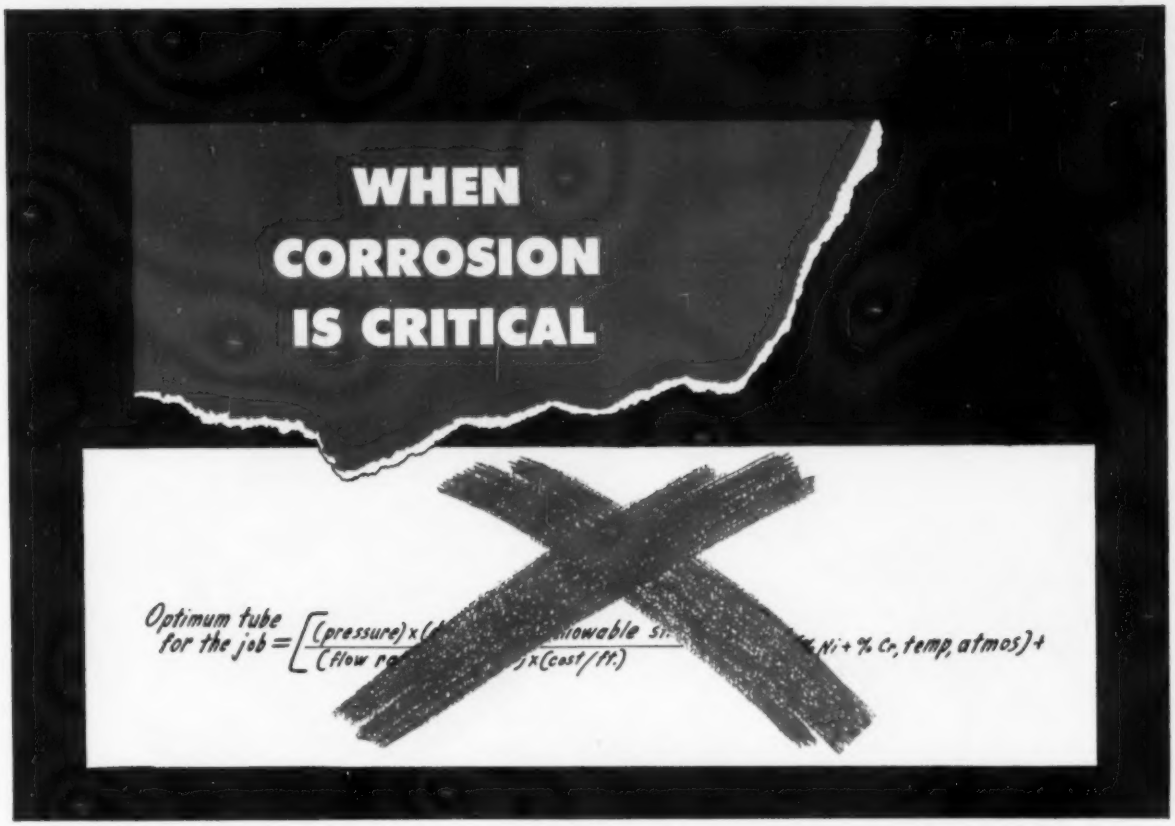
Circle No. **15** *on Reply Card*



Torsional Viscometer Indicates Changes in Value Instantly

. . . and is said to have unlimited applications in industries where the homogeneousness of the final and the intermediate products is required. Designed by the Chemical Institute of Dr. A. G. Epprecht in Zurich, Switzerland, it is being made available in this country. The way it operates is this: Frictional forces, which are related linearly to the viscosity, are transmitted through a rotating measuring element to a rotable mounted motor, the torque of which is opposed by a precision, constant modulus hairspring. A pointer which is attached to the motor casing, indicates directly the viscosity. The instrument has three speeds, 20, 64, and 200 rpm. A gear box is incorporated for this purpose, and its design is such that measurements are unaffected by friction in the gearing. Drage Products, 406 32nd St., Union City, N. J.

Circle No. **16** *on Reply Card*



Tube Selection Cannot be Reduced to a Formula

—even a complicated one

Selection of the proper grade of stainless steel for a particular application is a relatively complex problem and involves manufacturing, metallurgical, chemical and economic considerations. Although it is complex it has been made easier by industrial research. Data accumulated through years of research and experience gained in helping to solve varied application problems are now available to guide the user in the solution of his present problems.

It is practically impossible to list all the media in which stainless steels will resist corrosion. It is even more difficult to enumerate all the conditions under which the stainless steels will resist effectively the corrosive effects of such media. Frequently, a relatively minor contaminant, when combined with the main reagent, will cause a more detrimental corrosive action than the latter by itself. This is particularly true of iron salts which, in the presence of chlorides, often prove to be a very potent corrodent, producing pitting.

It is always advisable to test a sample under actual operating conditions, especially before extensive untried installations are made. Proper tube selection starts with expert opinion, available to you through Mr. Tubes, your nearby B&W Tube Representative. There is no substitute for the kind of experience with pressure tubing problems you'll find at B&W. Ask Mr. Tubes for help in matching tubes to jobs.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

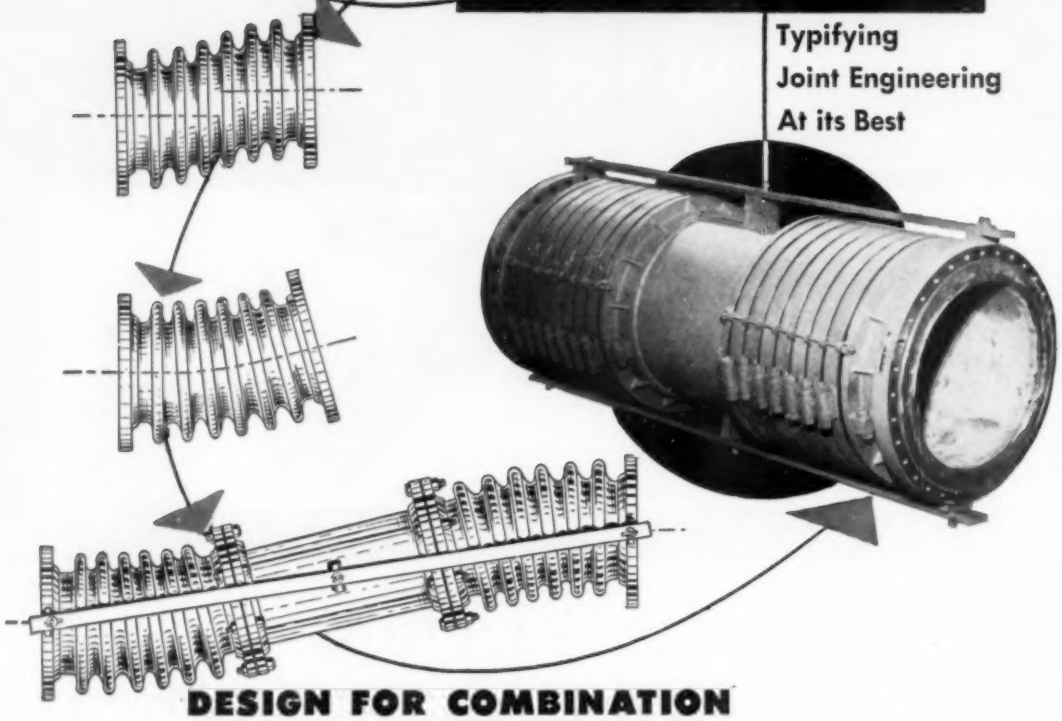
B&W SEAMLESS and WELDED TUBES

TA-4061(P)

Badger

EXPANSION JOINTS

Typifying Joint Engineering At its Best



DESIGN FOR COMBINATION LINEAR-SHEAR-LATERAL MOVEMENTS

Study these sketches showing (somewhat exaggerated, of course) several of the more complex movements to which expansion joints are often subjected. Do you have such pipe line conditions? Do you have any installation coming up that might involve such movements?

Here's the Badger Joint that is designed for just such a problem: the TANDEM JOINT. It's available in both Self-Equalizing and Non-Equalizing design. The joint movement is controlled by the tandem bars pivoting on a pin in the connecting nipple. Permissible shear or lateral movement depends upon the overall length as well as the number of corrugations in each unit. Each tandem unit is designed to suit the individual job requirements.

The Tandem Joint is but one of several special types designed for complex pipe line movements. We'll be glad to study your problem and make recommendations. Should yours be a straight linear traverse—as most installations are—we have a wide range in Directed Flexing, Self-Equalizing and Non-Equalizing Joints made of copper or stainless steel, with flanged or welding ends.

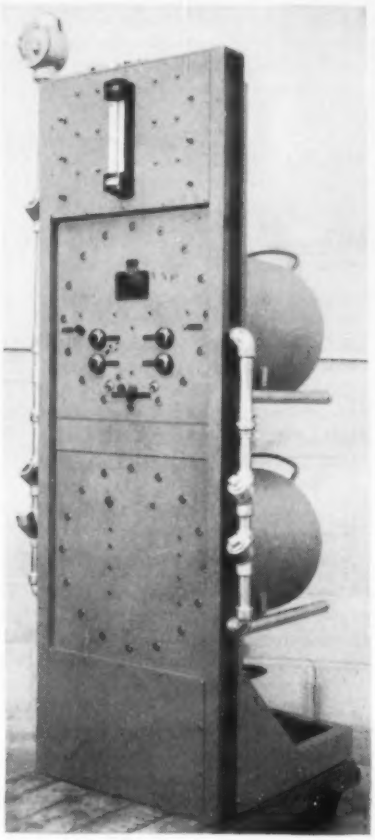
Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for longer traverses and higher pressure; Non-Equalizing, for shorter traverse or when pressures are low. Tandem Joints for combination axial and lateral movements; Clevis Joints for angular rotation.

Special Vibration Control Joints; Flexible Pipe Line Seals for watertight connection between pipe and flood walls.

BADGER MANUFACTURING COMPANY

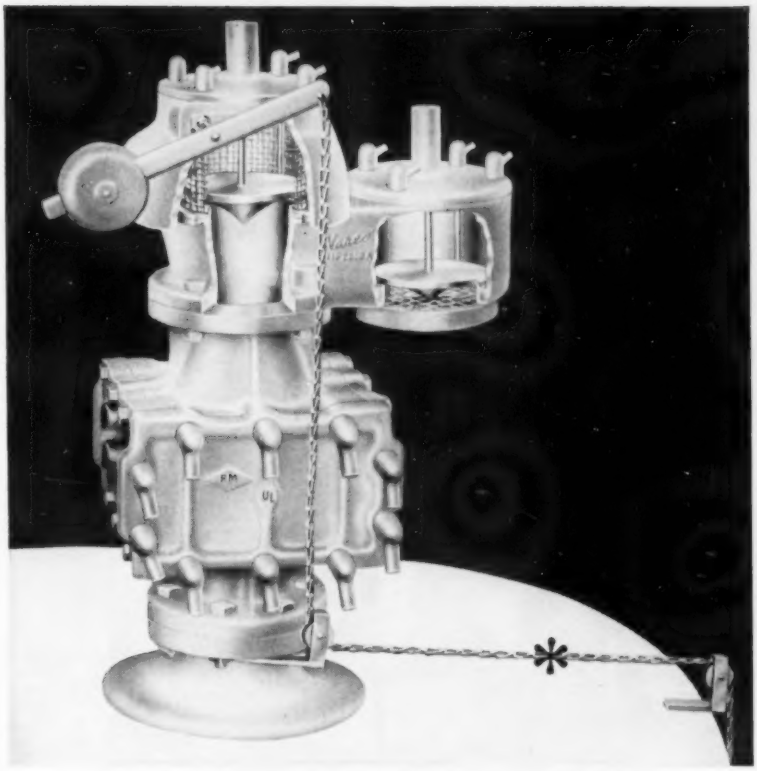
Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE 41, MASS.



New Multiple Stream Infrared Analyzer Built for Plant Uses

. . . by Phillips Petroleum has already been used successfully in a wide variety of field applications. The analyzer employs an optical system of the double-beam, filter photometer type using non-selective detectors. Completely automatic, it can be used to monitor cyclically as many as five process streams for a single component or a group of components. Alternatively, it can utilize continuous single-stream analysis for direct process control. Housed in dual bells designed and tested to be explosion-proof for Class I, Group B, hazardous locations, the entire unit requires a floor space of about 4 by 6 ft. Periodic, automatic standardization is employed to compensate for ambient temperature and barometric fluctuations. information from the unit can be telemetered any reasonable distance from a low impedance output designed to minimize possible stray pickup. Sampling system design and components can be supplied with the instruments. The analyzers are available by direct purchase or on a rental basis with optional subsequent purchase. Complete sam-



EFFICIENT VENTING CUTS VAPOR LOSS

Considerable profits are dissipated to the atmosphere when vent pallets warp, stick open or prevent excessive "blowdown." "VAREC" Fig. No. 5800 Conservation Vent Units are ideal equipment for venting volatile or inflammable liquid storage. They protect against dangerous over and under pressures and accidental ignition. Streamlined passages insure maximum flow. Regrindable and renewable metal pallet seats provide extra long life. Drip rings eliminate condensate collection, reducing possibility of freezing. Hyperbolic pallets, loosely guided, prevent sticking and minimize flutter. Flame Arrester unit listed by Underwriters' Laboratories and approved by Factory Mutual Laboratories. Send for free Bulletin CP-2001.

* *Remote Control Flame Snuffer Sheave Brackets, Fig. 130 are optional at extra cost. This assembly is preferable where vent unit is set back from edge of tank.*

"Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY

COMPTON, CALIFORNIA

Cable Address: VAREC COMPTON CALIF. (U. S. A.) All Codes

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CANADA, Montreal	Peacock Bros. Ltd. Town of La Salle
CANADA, Toronto	J. F. Comer Co., 508 Federal Bldg., 85 Richmond St. West
HOLLAND, Amsterdam C	Comprimo N. V. Amstel 21C
JAPAN, Tokyo	American Japan Trading Co., 213 Chrom Ginza Chuo-Ku
MEXICO, Mexico City 4, D.F.	Schultz y Cia., S. A., Col. San Rafael, Sullivan 119
SWEDEN, Stockholm	Kemi-Intressen, P.O. Box 16363
SWITZERLAND, Zurich	Urania-Acessories, Newmuhlequai 24
VENEZUELA, Barcelona	Waldrip-Campbell, Apartado 30
VENEZUELA, Marcaibo	Waldrip-Campbell, Apartado de Correo 594

FOREIGN MANUFACTURING LICENSEES:

ENGLAND, London	Wm. Neil & Son, Ltd., 38 Victoria St. S.W.1.
FRANCE, Paris	Compagnie Tech. des Petroles, 134 Blvd. Haussman

58-1

(To obtain more data on advertised products see page 1112)

pling system design and maintenance services are supplied with the rental equipment. Phillips Petroleum Co., Instrument Sales Div., Bartlesville, Okla.

Circle No. **17** *on Reply Card*

Trade Literature

Gas Analyzer

. . . said to be sensitive enough to detect gas concentrations of five parts per billion, using a method employing mercury vapor in ultra-violet light; *Bulletin* 501 gives specifications, a list of applications and a diagram of the instrument's operation. Taller & Cooper, Inc., 75 Front St., Brooklyn 1, N. Y.

Circle No. **18** *on Reply Card*

Synthetic Urea Process

. . . as developed by the company, featuring a full recycle with a high conversion per pass, *Bulletin F*103 contains flow diagram of process, list of advantages. Chemical Construction Corp., 488 Madison Ave., New York 22, N. Y.

Circle No. **19** *on Reply Card*

Stripping Column Control

. . . system for protecting direct steam-heated columns against pressure build-ups caused by clogged trays; two-page *Application Engineering Data Sheet* AED 282-6, explains the system in detail. The Foxboro Co., Foxboro, Mass.

Circle No. **20** *on Reply Card*

Pump Fundamentals

. . . in a booklet explaining the operating principles of a centrifugal pump; includes definition of terms used in calculations and a section in which typical pump problems are worked out. Ingersoll-Rand Co., Cameron Pump Dept., 11 Broadway, New York 4, N. Y.

Circle No. **21** *on Reply Card*

Motor Selection Data

. . . for choosing proper model for each application; bulletin *B*-2102 includes prices for protected and totally enclosed, fan cooled motors, and dimensions; illustrations of different types of motors accompany the text. Reliance Electric and Engineering Co., 1076 Ivanhoe Rd., Cleveland 10, Ohio.

Circle No. **22** *on Reply Card*

For Easy Pipe Threading 2½" to 4"... it's the 4P

RIDGID

Every 4P TESTED for Perfect Threads before shipment

RIDGID 4P is easy to carry, easy to put on pipe

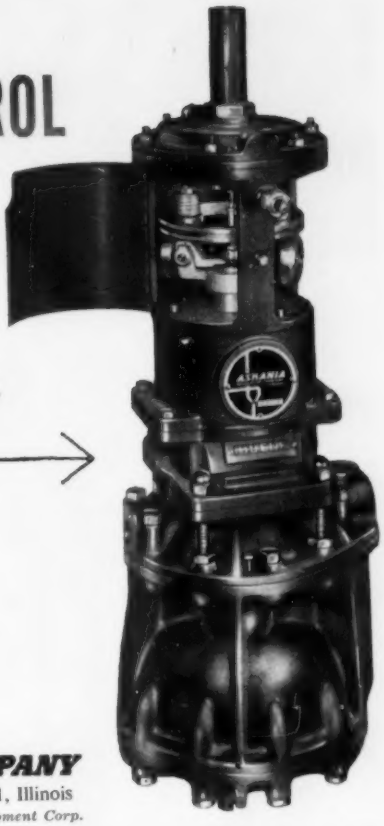
Balanced loop handles make it a cinch to carry and swing up on a pipe! Besides, the mistake-proof workholder sets to size before you lift it—only one screw to tighten on pipe. Easy upkeep—drive pinion in oilless bronze bearing; safe enclosed gear. 4 sets of 5 high-speed steel dies, 2½", 3", 3½", 4". Ratchet handle. RIDGID drive shaft available. Save work—buy 4P at your Supply House.

The Ridge Tool Company • Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

FOR MEASUREMENT and CONTROL of VISCOUS FLUID FLOW...

the ASKANIA TRANSOMETER



Designed for fuel oil and other viscous liquids, the Askania Transometer accurately measures flow and transmits a corresponding pneumatic signal.

This signal can be in the range of inches w. c., to match equivalent gas flow measurement; or in the standard instrument transmitter range of 3-15 p.s.i.

Sturdy Askania construction, over-range protection, built-in integrator, wide range. Write for Bulletin 125.

ASKANIA REGULATOR COMPANY
244 E. Ontario Street, Chicago 11, Illinois
Subsidiary of General Precision Equipment Corp.

ANNOUNCING THE THIRD ANNUAL PETROCHEMICAL MARKETS ISSUE

The September issue of *Petroleum Processing* is your key to the tremendously expanding Petrochemical Industry. In 1953 approximately 25% of all chemicals were petrochemicals. By 1962, just 10 years, it is estimated that 50% of all chemicals produced will be petrochemicals. This will make necessary a huge expansion program which points up the almost unlimited market for all types of equipment—i.e. furnaces, heat exchangers, fractionating towers, pumps, valves, pipes and tubes, fittings, of many types, controls and instruments and many more materials and process equipment.

***Petroleum Processing* is your key to this market because *all* classes of refinery buying influences—management, engineers, foreman—depend on *Petroleum Processing* to keep them informed on new developments in plant equipment and processes.**

To find out how you can participate in this, the biggest publishing event of the year in petrochemicals, contact your nearest *Petroleum Processing* representative, as listed on page 985 or write direct to:

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(their escape means continuous added costs and annoyance to your neighbors)

MMC CATALYST FILTERS

replace cyclones and electrostatic precipitators and offer

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- **low pressure drop**
- **hi-temp service**
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Another engineered filtration service using porous stainless steel by

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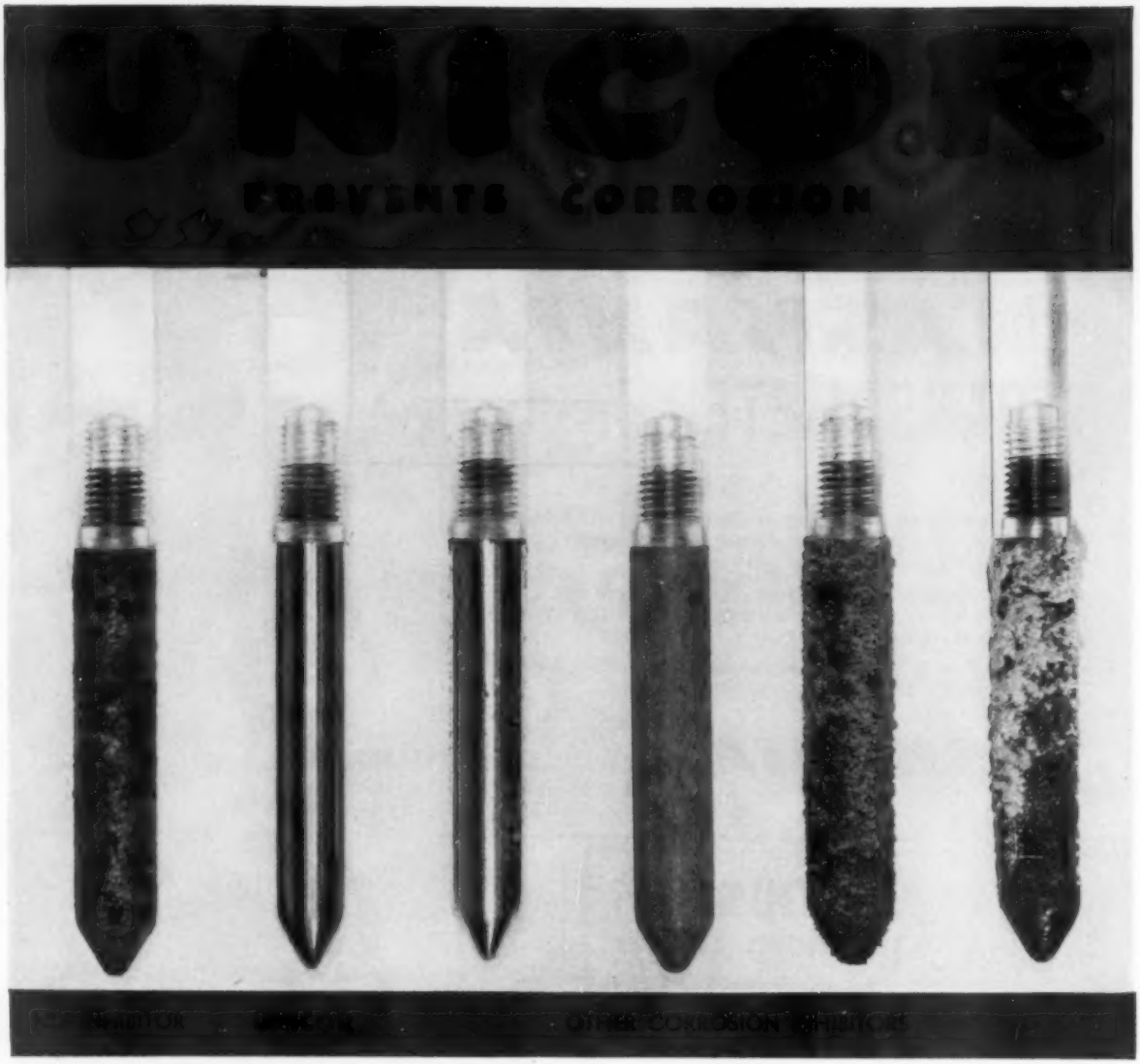

ONLY **UNICOR** PASSES RIGID ASTM TEST

The progressive refiner turns to Unicor to solve his corrosion problems. Here's why:

The test pieces shown above were submerged for 48 hours in a dynamic system of sea water and oil. In each case the oil contained a different, well-known corrosion inhibitor.

The test specimen exposed to the mixture inhibited with Unicor was the only one to remain as bright and unpitted as a freshly prepared, unexposed test piece. All of the other inhibitors permitted varying degrees of corrosive attack.

These results were obtained by using the procedure of ASTM D 665-53T — the generally accepted method for determining the corrosion-preventing characteristics of inhibited hydrocarbon oils.

The specific conditions involved exposure to the action of synthetic sea water, air and sour catalytic cycle stock at a temperature of 140° F. for 48 hours.

Similar results were obtained with gasoline and other distillates by using this and other types of tests, including the Navy Static Water Drop Test.

In the field as well as in the laboratory Unicor has proved to be the ideal, economical corrosion inhibitor.

Refiners everywhere are turning to Unicor as the best solution to their corrosion problems.

Let UOP Engineers design and service a UNICOR System to protect your refinery.

WRITE FOR SAMPLES AND LITERATURE
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UNIVERSAL OIL PRODUCTS COMPANY
30 ALGONQUIN ROAD,
DES PLAINES, ILL., U. S. A.

What's New!

Rotary Compressors

. . . single-stage, water-cooled, and vacuum pumps are the subjects of Bulletin 16 *B* 8126; general specifications for the units are given, as well as typical air piping arrangement diagrams and details about accessories. Allis Chalmers Mfg. Co., 836 S. 70th St., Milwaukee, Wis.

Circle No. **23** *on Reply Card*

Industrial Television

. . . closed circuit, with many applications, including process control in refineries; 4-page *Catalog E* 50 describes features and applications, has photos of unit and its components, and specifications. Radio Corp. of America, Camden, N. J.

Circle No. **24** *on Reply Card*

New Antioxidant

. . . for use in hydrocarbon materials, "dbpc"; *Technical Bulletin C*-4-115 gives its chemical composition and reactions, uses with lubricating and transformer oils, gasoline, specialty oils, etc.; also, bibliography of references and sales information. Koppers Co., Inc., Chemical Division, Koppers Bldg., Pittsburgh 19, Pa.

Circle No. **25** *on Reply Card*

Flame-Electrode Rectifier

. . . units and component parts are described in *Bulletin* 9604; specifications and construction details are given for the pilot, chucks and adapters, electrodes, and miniature flame rod assemblies; insert supplies prices. Minneapolis - Honeywell Regulator Co., Philadelphia 44, Pa.

Circle No. **26** *on Reply Card*

Midget Solenoid Valve

. . . four-way, with an over-all length under 3 in. and depth of 2 in.; *Bulletin* 8345 gives general description, applications, special features, schematic flow diagram. The Automatic Switch Co., Orange, N. J.

Circle No. **27** *on Reply Card*

Fireclay Brick

. . . with greater refractoriness and resistance to spalling, for high temperature service; bulletin describes company's two "super-duty" types of brick—"Alamo" and "Varnon"; charts compare performance of these types with high duty fireclay brick. Harbison-Walker Refractories Co.

Circle No. **28** *on Reply Card*

J-M BLAZECRETE builds longer lasting refractory linings . . .

That's why it pays you to use this hydraulic setting refractory for temperatures to 3000F

Blazecrete* linings last longer because they resist spalling, withstand slagging action, and are not harmed by rapid temperature changes.

Thus you cut down on refractory maintenance costs—and you save on labor costs, too, because Blazecrete goes on fast. For troweling, just mix Blazecrete with water as you'd mix ordinary concrete . . . then slap-trowel it in place. When gunned, it adheres readily with a minimum of rebound loss. Either way, Blazecrete may be applied easily without laborious ramming or tamping.

Three types of hydraulic-setting Blazecrete are available. All harden on air curing, do not require prefiring. They are furnished as a dry mix—can be stored safely for use as needed.

3X BLAZECRETE—For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for forge furnace linings, lime kilns, burner blocks, soaking pits, and industrial boilers.

STANDARD BLAZECRETE—For temperatures through 2400F. Makes repair work easier and less costly. Can be used by boiler manufacturers to replace fire clay tile in wall construction. Suitable for use in combination with 3X Blazecrete and L. W. Blazecrete.

L. W. BLAZECRETE—For temperatures through 2000F. An insulating refractory . . . light in weight, low in thermal conductivity. Adaptable and economical for many other applications.

Send for Brochure RC-28A on Blazecrete and its companion material, Firecrete*. . . the hydraulic-setting castable refractory for making special shapes and linings. Write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Reg. U.S. Pat. Off.

Whether you gun it... *or slap-trowel it...*

JM PRODUCTS **Johns-Manville BLAZECRETE**

BUILDS BETTER REFRACTORY LININGS

(To obtain more data on advertised products see page 1112)

Have you tried "that new snap-on PIPE INSULATION?"

"That new snap-on pipe insulation" that's causing so much comment in industry is G-B SNAP*ON PIPE INSULATION. It's the first and ONLY one-piece molded pipe insulation of fine glass fibers — ideal for hot or cold piping, for plant maintenance or new construction.

To the many advantages you see illustrated below, you can add ECONOMY. G-B SNAP*ON PIPE INSULATION costs no more than other insulations, and users report APPLICATION SAVINGS UP TO 50%!

ONE MAN, ONE HAND — that's all it takes to handle new G-B SNAP*ON PIPE INSULATION. (This 6-foot section weighs just a shade over 4 lbs.!) No harm done if the workman should drop it — for this insulation is flexible and resilient, won't break or crumble.

A "SNAP" TO APPLY — simply pull the single seam apart, and G-B SNAP*ON PIPE INSULATION snaps itself around the pipe! No special tools or skills required. With any knife, you can readily cut this new insulation to go around obstructions.

EASY TO FINISH — simply close seam tightly with any standard type fastener — then paint . . . leave "as is" . . . or finish as desired. Thermal efficiency of the finished job is so superior that you get the same "heat saving" with less wall thickness!

For samples and complete information, write today!

*G-B Snap*On Pipe Insulation is available in sizes from ¾" to 24" in diameter, and in varying wall thicknesses.*

gb **GUSTIN-BACON MANUFACTURING CO.**
266 W. 10TH ST., KANSAS CITY, MISSOURI
New York • Chicago • Philadelphia • San Francisco • Los Angeles
Houston • Tulsa • Dallas • Detroit • St. Louis

What's New!

Air Pollution Sampler

. . . is described in a reprint of an article: "A Low-Cost Sampler for Measurement of Low Concentration of Hydrogen Sulfide," by J. Deane Sensenbaugh and W. C. L. Hemeon, Industrial Hygiene Foundation, Mellon Institute, 440 Fifth Ave., Pittsburgh 13, Penna.

Circle No. **29** *on Reply Card*

pH Electrodes

. . . and electrodes for measuring Redox potentials—assemblies, parts, and accessories—are described in new *Catalog EN-S5*. Leeds & Northrup Co., Advtg. Div., 4907 Stenton Ave., Philadelphia 44, Penna.

Circle No. **30** *on Reply Card*

Isobutylene Extraction

. . . as a petrochemical, as practiced by Esso Standard Oil Co. in a 20,000 gal./day unit at Bayway; described in a 6-page article in *Alco Products Review*, Spring, 1954, issue. American Locomotive Co., 30 Church St., New York 8, N. Y.

Circle No. **31** *on Reply Card*

Benzyl Mercaptan

. . . for use in organic syntheses, as a softening agent for "Thiokol" polysulfide polymers, and as a corrosion inhibitor in the production of petroleum products: *New Product Bulletin* No. ZC-121. Thiokol Chemical Corp., 780 North Clinton Ave., Trenton 7, N. J.

Circle No. **32** *on Reply Card*

Tube Fittings

. . . in brass, aluminum, steel, and 316 stainless steel, of the "Hi-Duty" line; using no loose sleeve, no flaring soldering or brazing, and no special preparation of the tube; two pages of engineering data and drawings. Samuel Moore & Co., Dekoron Products Div., Mantua, Ohio.

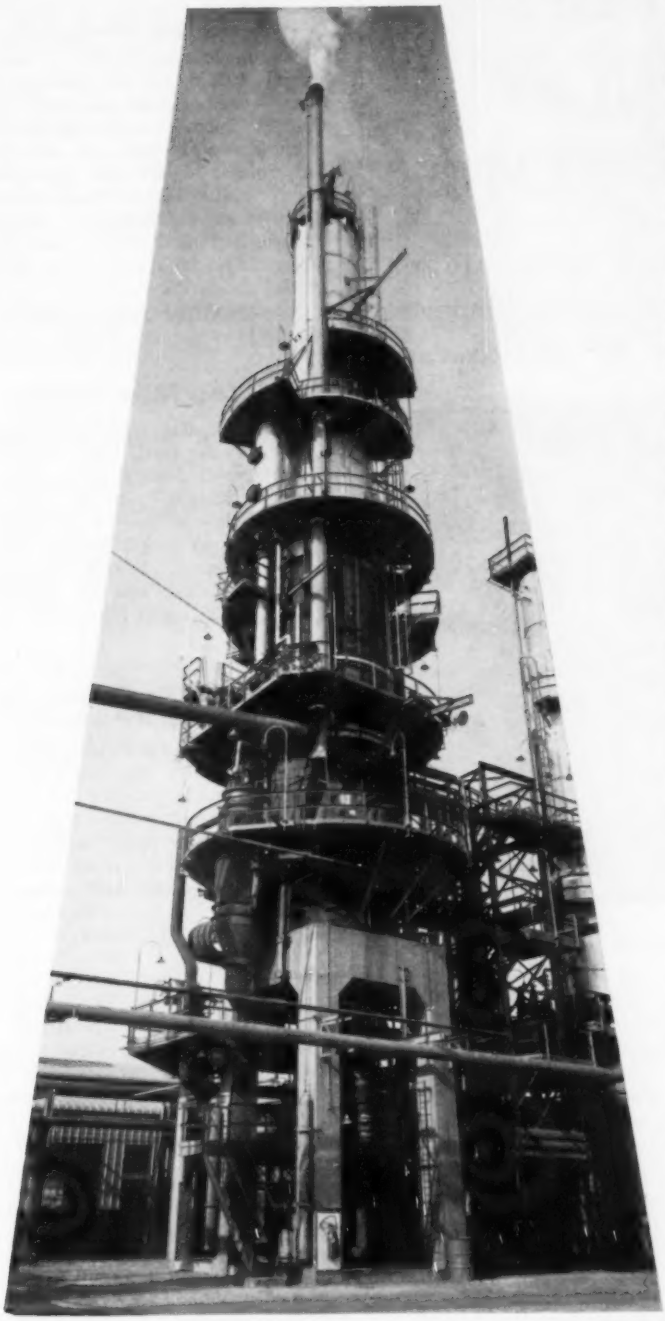
Circle No. **33** *on Reply Card*

Liquid Level Gage

. . . recorder, of the Anderson design (see Plant Practices, PETROLEUM PROCESSING, March, 1953, p. 398), designed to bring the surface level of the liquid to the top of the tank in a tube clamped to the tape; one-page leaflet. Bico, Inc., 3116 Valhalla Drive, Burbank, Calif.

Circle No. **34** *on Reply Card*

REACTOR REGENERATOR



built for Louisville refinery

Chicago Bridge & Iron Company recently built the 7000-bbl. per day reactor regenerator complete with platforms, shown at left for the Louisville Refining Company at Louisville, Kentucky.

For more than 64 years, Chicago Bridge & Iron Company has been called upon by the petroleum industry to solve complicated and unusual welded steel plate problems. Today, CB&I's plants have complete equipment for fabricating structures of carbon steel, carbon steel lined or clad with non-corrosive metal, and structures of solid non-corrosive metals. We also have complete facilities for pickling and painting fabricated steel plate and for x-raying and stress-relieving to code requirements. Our engineering, fabricating and erection departments are backed by the years of experience and facilities required to build refinery structures to engineering specifications.

Information, estimates or quotations on any Horton® welded steel plate structure may be obtained by writing our nearest office. There is no obligation on your part.

WELDED STEEL PLATE STRUCTURES FOR THE PETROLEUM INDUSTRY

Horton Floating Roofs	Refinery Towers
Horton Vaporspheres	Hortonspheroids
Horton Vaportanks	Hortonspheres
Flat Bottom Tanks	Hemispheroids
Hortondome Roof Tanks	Elevated Water Tanks

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNSYLVANIA

Atlanta 3 ..... 2103 Healey Building
Birmingham 1 ..... 1527 North Fiftieth Street
Boston 10 ..... 1029—201 Devonshire Street
Chicago 4 ..... 2114 McCormick Building
Cleveland 15 ..... 2215 Midland Building
Detroit 26 ..... 1532 Lafayette Building
Houston 2 ..... 2130 CGI Life Building
Los Angeles 17 .. 1526 General Petroleum Building
New York 6 .... 3310—165 Broadway Building
Philadelphia 3 ... 1630—1700 Walnut St. Building
Pittsburgh 19 ..... 3236 Alcoa Building
Salt Lake City 4 ... 530 West 17th South Street
San Francisco 4 ..... 1559—200 Bush Street
Seattle 1 ..... 1330 Henry Building
Tulsa 3 ..... 1620 Hunt Building

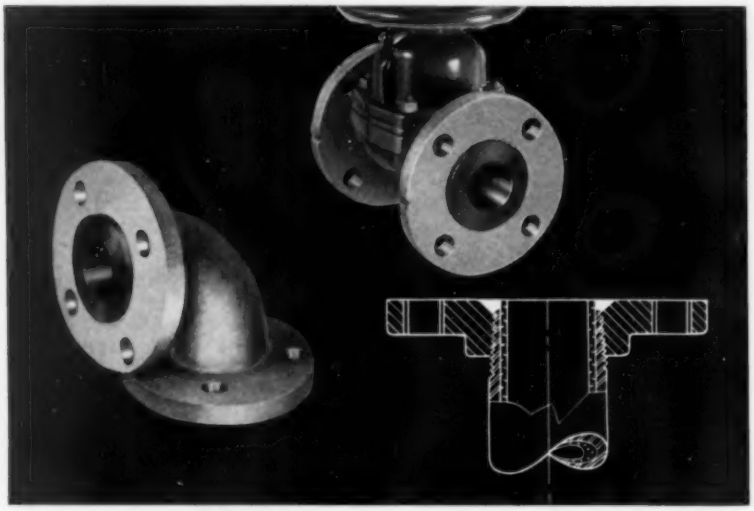
REPRESENTATIVES AND LICENSEES

Horton Steel Works Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348 Caracas, Venezuela
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Comprimo, N. V., 21, Amstel, Amsterdam (C) Netherlands
Sociedade Chibridge de Construcoes Avenida General Justo, 275, Grupo 306, Rio de Janeiro, Brazil

DOW

SARAN LINED PIPE IS UNAFFECTED BY SOUR CRUDE DISTILLATES

Saran lined pipe, fittings and valves resist corrosive end-products and acidic treating agents . . . eliminate production losses and downtime for replacements



The various corrosives encountered in the production of gasoline, kerosene and fuel oil from sour crudes point up another cost-saving application of saran lined pipe, fittings and valves. The other corrosives used in oil processing installations such as sulfuric acid, hydrofluoric acid and ferric chloride are all handled equally well. Downtime is cut to a minimum because this steel-clad rigid pipe has high pressure strength and great durability under severe conditions—which means dependable long-time service. Easily installed, saran lined steel pipe can be cut and threaded on the job—almost as quickly as dimensions can be taken! Wherever superior resistance to corrosives is required, be sure to consider saran lined pipe, fittings and valves. We'll be glad to assist with installation plans. Contact your nearest Dow sales office or write THE DOW CHEMICAL COMPANY, Midland, Michigan.

RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

Dow Chemical Company, Midland, Mich.
Plastics Sales Department, PL1165G
Please send me a copy of your catalog on saran lined pipe, fittings and valves.

Name_____
Title_____
Company_____
Address_____
City_____ State_____

you can depend on DOW PLASTICS DOW

What's New!

Heat Exchanger Tubes

. . . made from aluminum with a special cladding for corrosion protection; "Alcoa Aluminum Heat Exchanger Tubes" reports applications of aluminum exchangers in petroleum and related industries, gives heat transfer and fluid flow characteristics, specifications, estimating data and mechanical characteristics. Aluminum Co. of America, 728 Alcoa Bldg., Pittsburgh 19, Pa.

Circle No. **35** *on Reply Card*

Did You Miss These?

The following items, reviewed originally in April, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.

H_2S Measured Continuously by Density of Stain It Produces

. . . on a special sensitized paper in a sealed chamber. The new Type SU Hydrogen Sulfide Detector consists of three basic components: 1) a chart recorder, scaled in ppm. as required, arranged for panel mounting and with a front-hinged door; 2) a combined sampling and detecting unit; and 3) a glass tube type flow meter to check gas sampling rate. The instrument can be arranged to provide full scale ranges from 200 ppm. (maximum) to 0.05 ppm. (minimum). The device is set so that flow sample gas and rate of travel of the test paper are carefully controlled and constant. The amount of stain on the paper from the gas then becomes directly proportional to the amount of hydrogen sulfide in the gas. Actually, flow and paper travel are not continuous: they are intermittent at precisely timed intervals so that the stains appear as a series of dots or spots. Stain intensity is measured by the photoelectric cell method. Viking Instruments, Inc., East Haddam, Conn.

Circle No. **36** *on Reply Card*

New Transmitter Makes Positive Seal Between Gage and Fluid

. . . being measured. The Model "6100F" pressure transmitter is for use with pneumatically-operated instruments for measuring the pressure of liquids and gases—or the depth,

weight, or volume of liquids—in vented and in pressurized tanks. Because of the seal, it can be used with many fluids otherwise dangerous and difficult to measure. The diaphragm is the only part exposed to the fluid. The instrument is essentially a 1-to-1 transmitter. It has linear response from ½-in. water upward. It will permit accurate readings at all pressures to 20 psi. in vented tanks, and 45 psi. in pressurized tanks, and it will withstand pressures of 250 psi. without damage. Air consumption is less than 2SCF/hr. King Engineering Corp., Box 540, Ann Arbor, Mich.

Circle No. **37** *on Reply Card*

Sonic Liquid Level Indicators

. . . with accessories; manual and automatic calibration; *Bulletin S-68* gives description of systems, applications, diagrams of typical installations. Dept. SL, Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson, N. J.

Circle No. **38** *on Reply Card*

Anhydrous Ammonia

. . . physical properties, uses, specifications, shipping, handling and storage information are in *Technical Data Sheet 22*. Commercial Solvents Corp., 260 Madison Ave., New York 16, N. Y.

Circle No. **39** *on Reply Card*

Fractionator Tray Manual

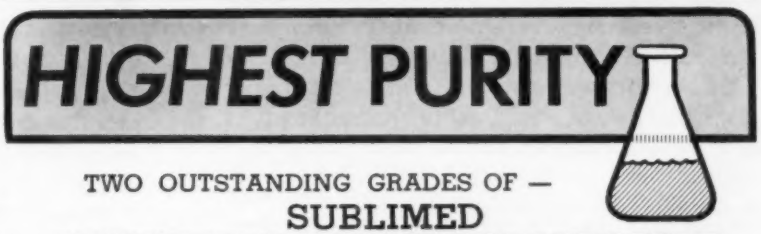
. . . for installation of the manufacturer's "Truss-Type" bubble trays; *Bulletin No. 154* contains 26 pages of technical and engineering information, data, and help for the user. Fritz W. Glitsch & Sons, Inc., P.O. Box 6227, Dallas 2, Texas.

Circle No. **40** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of Petroleum Processing to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item. Then fill in the rest of the card and drop it in the mail. No postage is required.

DURAMETALLIC
PACKINGS
SAVE at the
point of sealing . . .
Repacking time costs money! That's one reason why it pays to specify Durametallic self-lubricating, long-lasting packing for your specific sealing need.
Write today for File No. DMPP . . . it will be an important step toward securing the right packing for your particular equipment and sealing problem.
Durametallic Products are "Engineered For The Job"
The PERFECT SEAL
DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN


HIGHEST PURITY
TWO OUTSTANDING GRADES OF —
SUBLIMED
ANHYDROUS ALUMINUM CHLORIDE
THE PUREST COMMERCIAL MATERIAL AVAILABLE
— SPECIFICATIONS —
1. RESUBLIMED GRADE:
COLOR: White to very Lt. Yellow
SUBLIMINATION: Min. 99% gran. or lump
Min. 98.5% powder
WATER INSOLUBLE: None
HEAVY METALS: None
IRON CONTENT: Max. 0.01%
2. TECHNICAL GRADE (SUBLIMED):
COLOR: Lt. Yellow to Gray
SUBLIMINATION: Min. 98% gran. or lump
Min. 97.5% powder
WATER INSOLUBLE: Max. 1.0%
HEAVY METALS: Trace
IRON CONTENT: Max. 0.05%
Both Grades May Be Had In Standard Or Special Particle Sizes
WRITE FOR OUR COMPLETE TECHNICAL CATALOG
OHIO APEX fmc
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(To obtain more data on advertised products see page 1112)

FINANCIAL AID TO HIGHER EDUCATION

What Business Can Do to Help Our Colleges and Universities

Is the financial squeeze now gripping our colleges and universities grave enough to warrant direct action by the business community? If so, what can business do about it? This editorial is addressed to these two questions.

In the previous editorial in this series of two, it was demonstrated that **our colleges and universities, and particularly the independent institutions, face financial difficulties, which, unless relieved, promise to get progressively worse and might ultimately result in a national disaster.** This state of affairs obviously gives the business community a crucial stake in helping to relieve the plight of these institutions. For our business organizations can be no stronger than the total community of which they are a part.

It does not follow automatically, however, that every business firm should give direct financial aid to education. Already the business structure is heavily burdened with activities unrelated to its main purpose. These include acting as tax collector for more than $65 billion of federal, state and local taxes in the year 1953. There is a limit to the amount of such public enterprise that can be loaded on the business system.

Business Holds Key to Answer

If, however, the survival of a key part of our educational system depends on its having financial help from the business community, that help should be provided. And this is the situation of our independent privately endowed colleges and universities.

Of course, our tax-supported institutions of higher learning must also be kept strong, financially and otherwise. But they have recourse to public support not available to the independent institutions. Largely on this account, their present financial difficulties are much less acute than those of the independent colleges and universities.

These independent institutions have seen price inflation eat away much of the value of their endowments. Moreover, there is no prospect that these endowments can be sufficiently replenished by gifts from the wealthy people who provided them in earlier years. Progressive income and estate taxes have seen to that. Thus, they are faced not only with a peculiarly acute financial problem, but also one which cannot be solved except by tapping other sources of aid.

Tax Support No Solution

It is conceivable that the independent colleges and universities might solve their financial problem by seeking support from tax revenues. If they did this, however, they would lose their distinctive character as independent institutions, and our system of higher education would lose one of its major elements of strength. That is the existence in our educational system of both independently financed and tax-supported colleges and universities. Each has its special contribution to make to a well-balanced system of higher education.

Business is directly dependent upon higher education to staff its increasingly complex and exacting operations. A key part in this process is played by the small, independent liberal arts colleges which are the hardest hit financially of all our institutions of higher learning. "These," states the Council for Financial Aid to Education, recently formed by a group of business leaders, "have contributed a high proportion of the intellectual, scientific and religious, as well as business leadership of the nation. Their programs are devoted to the teaching of values, particularly the values of freedom. They are a vital bulwark to our system of free enterprise."

Means of Providing Help

There are many means by which business firms can extend help to our colleges and universities. The most obvious, of course, is to make outright grants of money either to individual institutions or to groups of institutions for such uses as the institutions think best. Another means of help, increasingly employed by business firms, is to establish scholarships to pay the full cost of college or university courses of study. Sometimes the scholarships are open for general competition, sometimes they are limited to employees and children of employees of the firm granting them. Not infrequently those winning the scholarships spend some part of their school vacations working in the companies granting the scholarships.

A number of companies have recently provided for what have come to be called "scholarships in reverse." These companies pay a flat sum to a college or university for every one of its graduates they employ. Financing of university research programs also offers a broad avenue for financial aid to our universities by business.

Need Two-Way Communication

Some business firms have well-developed programs for financial aid to education. But they are exceptional. For most companies the problems involved are new and strange. These companies were created with the basic purpose to make money, not to give it away. Successful philanthopic operations involve a whole set of problems with which they have very little experience. Not the least of these is how to make business a dependable source of financial aid to education, since business has no assurance that the profits of one year will not be losses the next.

Considerations such as these emphasize the wisdom of a recent Industry-College Conference on aid to higher education by business, in making the first of its ten conclusions that "better communication, by direct contact, is needed for each [industry and the colleges] to understand the problems of the other." At this juncture the creation of mutual understanding is much more important than the raising of some money and letting it go at that. The problem of aid to education by business has its immediate urgency, but there is also a long-range program to be developed on which business and the colleges and universities must pull together in the years ahead to find a satisfactory solution.

As stated at the outset, failure to find a satisfactory solution could result in a national disaster. This means that, **to give proper heed to their own future prosperity and the future welfare of the nation, business firms generally must go to work on the problem of financial aid to higher education. They must go to work first, to understand the problem; second, to establish two-way communication with our colleges and universities about it; and third, to develop a program which pays proper heed to the needs and capabilities of both business and higher education.**

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

EDITORIALS . . .

What Can One Big Oil Union Offer?

WORKERS in the petroleum industry, particularly in refineries, should consider carefully the exent to which their individual status will be improved if the labor organizations which now represent them are merged into one big all-inclusive union.

Advocates of the one big union theory often refer to the benefits which workers in the coal, steel, automotive and a few other industries secured through their single unions embracing all types of workers.

But conditions in the petroleum industry are not comparable in any way with those in these other industries when the CIO moved in on them. These others employed a large proportion of unskilled labor, which had been held to lower wages than the prevailing scale. Early benefits were secured by the CIO union in bringing wages and working conditions up to the average for industry generally.

After this was done, and except for now seeing that these standards are maintained, one questions whether the autocratic union domination under which the workers in these industries now live is worth the earlier surrender of their individual rights.

The nature of operations in the petroleum industry and the relatively small proportion of unskilled labor employed create entirely different conditions than in most fields. Its workers are not underpaid, mistreated or denied their bargaining rights. Statistics of the U.S. Labor Bureau show refinery workers earned an average of $93.90 weekly in 1953, as compared with $71.57 for the average manufacturing worker. Non-wage benefits for refinery workers averaged $975 annually, as against $644 average for all industries.

The CIO leaders point to the higher degree of skill and productivity required in the refineries and question whether these workers are adequately compensated. This condition is already recognized by the oil companies, not only in the wages paid, but in the selection and training of operators to fill these jobs. Under one big union with seniority rights strictly upheld, would the men capable of filling these better jobs get the same opportunities as under the present structure of unions?

Most important of all, refinery workers for the most part live and work under conditions which maintain their individualities. Do they want to forego this priceless benefit and fit themselves into the uniform pattern of worker called for by an all-inclusive CIO union?

Go Ye and Study the Whales

WE were reading a book on whales the other day,* and though at first glance there may seem to be little connection between whales and petroleum processing it gave us an idea which might be of some interest to you.

At one point the author points out that the body fluids of the whale—even though he exists in an atmosphere of sea water—are no more saline than the same fluids of a mammal living on land. One of the book's characters is quoted as saying that a large blue whale "doesn't sweat out salt the way every land mammal does, and his urine's no more saline than yours is; and, unless he licks the ruddy icebergs, he's got no supply of fresh water to keep down his salinity. So somewhere in his body he must have an evaporator as big and efficient as the evaporators that produce fresh water on the whale catchers."

So to those of you interested in reducing the salt content of sea water to make it suitable for industrial processes uses, we suggest a study of the whale and other warm blooded animals that live in the sea.

*"Of Whales and Men," by R. B. Robertson, published 1954 by Alfred A. Knopf.

Is There a Metallurgist on the Staff?

IT has been aptly stated that corrosion protection is in transition from being an art to becoming a science. The current studies of deterioration of metals in petroleum processing plants bear this out since, in many cases, they are being pursued on a broader and more fundamental basis than ever before.

Today, studies searching for the basic causes of corrosion in almost all instances go back to the composition, heat treating or other working of the metals which have failed in usage. Thus the work reaches into the province of the metallurgist.

The importance of some understanding of metallurgy in the analysis of corrosion problems was demonstrated at the recent Petroleum Conference held by the International Nickel Co. at its corrosion laboratories near Wrightsville Beach, N. C. One session was given over to the subject of the stress corrosion cracking of high strength steels. Three fundamental factors are involved in this type of failure, it was brought out: the processing environment to which the material was submitted, its properties and characteristics as originally manufactured, and the applied stresses developing in its use. The discussion of two of these factors involved metallurgical considerations, and at least some of the oil company engineers present found themselves in deep water in this field of science—but they followed the discussions with great interest.

On other types of corrosion and deterioration of metals, such as hydrogen embrittlement and carbide precipitation in steels, knowledge of the original composition and properties of the material has been shown necessary to solving the specific problems.

More and more the oil companies are recognizing the need for this type of knowledge by putting metallurgists on the corrosion protection staffs in their refineries.

In future clinics of International Nickel Co. at Wrightsville Beach and at other conferences on corrosion in refineries, more and more metallurgists will be among the representatives of the oil companies present. Both their participation in the discussions and their application in their plants of their knowledge in this special field of science will help in the solution of specific refinery corrosion problems.

Which of these Fluorine Compounds do you need?

☑ for process uses ☑ for research

FLUORINE
Elemental Fluorine

ACIDS
Fluoboric Acid
Fluosulfonic Acid
Hydrofluoric Acid, Anhyd.
Hydrofluoric Acid, Anhyd. High Purity
Hydrofluoric Acid, Aqueous Tech.
Hydrofluoric Acid, Aqueous, Purif. & Reag.

ACID FLUORIDES
Ammonium Bifluoride
Potassium Bifluoride
Sodium Bifluoride

ALKALI FLUOBORATES
Ammonium Fluoborate
Potassium Fluoborate
Sodium Fluoborate

ALKALI FLUORIDES
Ammonium Fluoride
Potassium Fluoride, Cryst. & Anhyd.
Sodium Fluoride, Tech.
Sodium Fluoride, Reagent

DOUBLE FLUORIDES
Chromium Potassium Fluoride
Potassium Ferric Fluoride
Potassium Titanium Fluoride
Potassium Zirconium Fluoride
Sodium Zirconium Fluoride
Sodium Silico Fluoride
Potassium Aluminum Fluoride

METAL FLUORIDES
Aluminum Fluoride
Aluminum Fluoride, Crystal
Antimony Trifluoride
Antimony Pentafluoride
Barium Fluoride
Cadmium Fluoride
Calcium Fluoride
Chromium Trifluoride
Cupric Fluoride
Ferric Fluoride
Lead Tetrafluoride
Magnesium Fluoride (Not Optical Grade)
Mercuric Fluoride
Manganese Trifluoride
Molybdenum Hexafluoride
Nickelous Fluoride
Selenium Hexafluoride
Silver Difluoride
Strontium Fluoride
Titanium Tetrafluoride
Tellurium Hexafluoride
Tungsten Hexafluoride
Zinc Fluoride
Zirconium Tetrafluoride

NON-METALLIC FLUORIDES
Boron Fluoride Gas
Boron Fluoride Ether (Diethyl) Complex
Boron Fluoride Phenol Complex
Boron Fluoride Ammonia Complex
Boron Fluoride Diacetic Acid Complex
Boron Fluoride Di-n-Butyl Ether Complex
Boron Fluoride Dihydrate
Boron Fluoride Piperidine Complex
Boron Fluoride Ethyl "Cellosolve" Complex
Boron Fluoride Hexamethylene-tetramine Complex
Boron Fluoride Monoacetic Acid Complex
Boron Fluoride Para-cresol Complex
Boron Fluoride Triethanolamine Complex
Boron Fluoride Urea Complex
Sulfur Hexafluoride

METAL FLUOBORATE SOLUTIONS
Cadmium Fluoborate
Chromium Fluoborate
Cobalt Fluoborate
Copper Fluoborate
Ferrous (Iron) Fluoborate
Indium Fluoborate
Lead Fluoborate
Nickel Fluoborate
Silver Fluoborate
Stannous (Tin) Fluoborate
Zinc Fluoborate

HALOGEN FLUORIDES
Bromine Trifluoride
Bromine Pentafluoride
Chlorine Trifluoride
Iodine Pentafluoride

GENETRON® ORGANIC FLUORINE COMPOUNDS

Fluoromethanes

Trichloromonofluoromethane	CCl_3F
Dichlorodifluoromethane	CCl_2F_2
Monochlorodifluoromethane	$CHClF_2$
Trifluoromethane (Fluoroform)	CHF_3
Monochlorotrifluoromethane	$CClF_3$

Fluoroethanes

Difluoroethane (Ethylidene fluoride)	$CH_3 \cdot CHF_2$
Difluoromonochloroethane	$CH_3 \cdot CClF_2$
Tetrachlorodifluoroethane	$CCl_3 \cdot CClF_2$
Monochlorotrifluoroethane	$CH_2Cl \cdot CF_3$
Trichlorotrifluoroethanes	$CCl_2F \cdot CClF_2$ $CCl_3 \cdot CF_3$
Dichlorotetrafluoroethanes	$CClF_2 \cdot CClF_2$ $CCl_2F \cdot CF_3$
Monochloropentafluoroethane	$CClF_2 \cdot CF_3$

Fluoroethylenes

Difluoroethylene (Vinylidene fluoride)	$CH_2 = CF_2$
Dichlorodifluoroethylene	$CCl_2 = CF_2$
Trifluorochloroethylene	$CClF = CF_2$
Monochlorodifluoroethylene	$CHCl = CF_2$

Fluorobromoethanes

Dibromodifluoroethane	$CH_2Br \cdot CBrF_2$

Fluorinated Acetic Acids and Anhydrides

Dichloromonofluoroacetic acid and anhydride	CCl_2FCOOH and $(CCl_2FCO)_2O$
Monochlorodifluoroacetic acid and anhydride	$CClF_2COOH$ and $(CClF_2CO)_2O$

Fluorinated Acetones

Tetrachlorodifluoroacetone	$CCl_2F \cdot CO \cdot CCl_2F$
Trichlorotrifluoroacetone	$CCl_2F \cdot CO \cdot CClF_2$
Dichlorotetrafluoroacetone	$CClF_2 \cdot CO \cdot CClF_2$

Various Other Organic Fluorine Chemicals

Through aggressive research and development, General Chemical sets the pace in fluorine chemistry . . . making more and more of these versatile chemical "tools" available so that your development program today can become tomorrow's production.

Listed here are a hundred organic and inorganic fluorine compounds which General presently offers. Many are produced in carload, tank car or other commercial quantities. Others are made in pilot plants or intermittently on a laboratory scale for experimental uses. For some of these, studies of properties are in early stages. General has a number of other fluorine products under investigation in addition to those on the list; thus the company is geared to serve you well—now—and in the future.

That's why it's wise to see General Chemical when your work indicates the need for fluorine chemicals. With fifty year's experience in the field, we may be able to save you time, money and effort.

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Allied Chemical

For more information use the handy coupon.

GENERAL CHEMICAL DIVISION
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☐ Have a representative call on me_____
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Company_____
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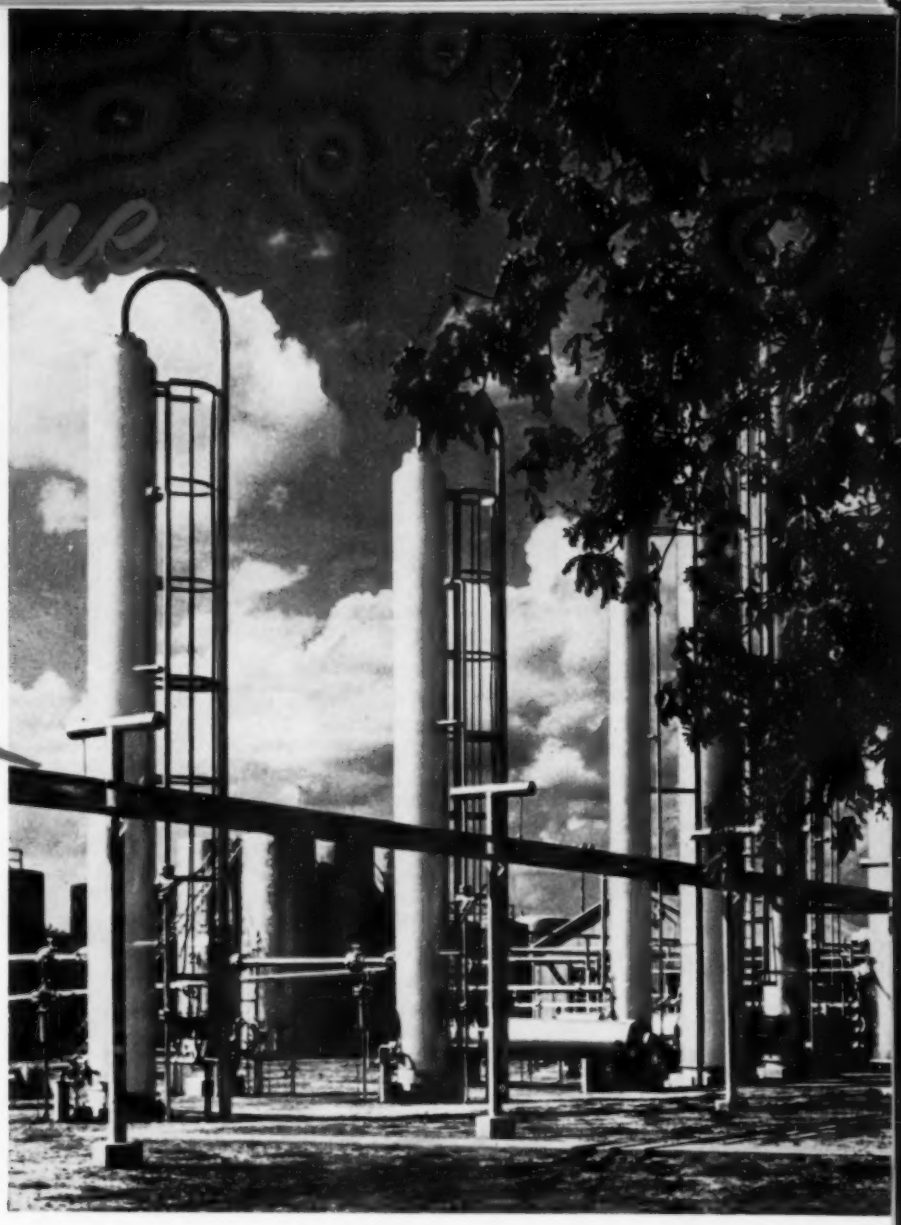
PP-7

Skyline by Wyatt



• Whenever the oil search comes up with a major strike of condensate, recovery must take place on the spot and the industry widens its processing skyline by calling for the skill of Wyatt fabrication.

MANUFACTURERS AND ERECTORS SINCE 1913